THE

# ELECTRICAL REVIEW.

VOL. LXI. OCTOBER 11, 1907. No. 1,559.

## ELECTRICAL REVIEW.

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THE
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(J. A. BERLY'S).

1907 EDITION.

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## ELECTRICAL CONTRACTOR OR IRONMONGER?

QUITE a little storm in a teacup has been raised by a contemporary, because the *Ironmongers' Chronicle* recently suggested that the hardwareman or ironmonger should devote more attention to electrical contracting than he has hitherto done. The *Chronicle* says:—"Our efforts are directed towards increasing the efficiency of all hardwaremen who are engaged in electrical work, and to opening up a new field of business for those who have hitherto stood aloof." In other words, the hardwareman looks upon electrical contracting as a side line to his ironmongery business.

In our issue of the 27th ult., in advocating a more aggressive policy in the matter of pushing the sales of heating appliances, we said:—"Provided that equitable prices are preserved, such goods can be handled quite well through ordinary ironmongers. . . . Although switchgear must be left to electrical traders, electric cooking and heating apparatus can be sold in much more general ways. In a matter of this sort the manufacturer, the contractor, the sales agent, and the electricity supply authorities all stand to gain from the wider use of such articles."

How such remarks as these can be construed into our "advocating that all and sundry—no matter who—should plunge into the [contracting] business"; how it can be argued from the above that we are opposing the Electrical Contractors' Association—an association we helped to bring into existence—in its efforts "to improve the status of the contractor and eliminate the 'grip sack' no account bungler," none but a journalist of the Carmelite School could explain. It is a pity that our young friends in the Strand did not leave behind them the methods of Carmelite Street when they stepped up into the cleaner atmosphere of electrical journalism.

We yield to none in the intensity of our desire to see the fullest possible use made of all electrical applications.

It is of no use to play the ostrich; facts do not alter because we shut our eyes to them, nor will the flinging of abuse bring back to the electrical contractor the work which the ironmonger, the builder, and the plumber and gasfitter have gradually appropriated.

In a leading article some 18 months ago, we pointed out that the tendency was for small contracting work, by which we mean the wiring of small properties, blocks of mansion flats, small shops, and the like, to drift into the hands of the building trades, and by the term building trades, we do not refer to bricklayers and stonemasons whose work finishes with the shell, but to the trades engaged in the interior, such as those who employ joiners, gas and bell fitters, plumbers and ironmongers.

In the wood-casing days, far more joiners than wiremen were engaged in electric wiring, and many joiners became

chargemen or foremen on electrical contracts. They often made better chargemen than the mere wireman did, due to the better and more methodical training they had received. Hence we find to day that some cabinet-making and upholstering firms run an electrical department as a side line.

Nowadays, when lead and iron piping or conduit has so largely superseded wood-casing for enclosing the wires, a very large portion of the work of erection is practically plumbers', gasfitters', or ironmongers' work. It would be demanding something almost more than human to ask these tradesmen to quietly stand on one side and see their trades gradually pass into the hands of the new-comer, the electrical contractor, without making some attempt to retain them by acquiring a working knowledge of electric wiring.

Engine-builders passed through a somewhat similar experience when Willans introduced his high-speed engine. They had to grin and bear it, whilst Willans & Robinson in building up their magnificent business took order after order which formerly would have gone to the older firms. No doubt when the older established engineering firms designed and put on the market competitive high-speed engines, the firm which had created this new field felt aggrieved, and said, like electrical contractors are saying to-day, "What right have these people to cut into our market, what can they know about *our* business?" But no one to-day would question the right of any firm to make either a steam engine or a gas engine, whether of the high or the low speed type.

Again, in one of the higher walks of the electrical industry, the consulting profession, the same cycle of experience has taken place. The older order of consultants, viz., the civil engineers, watched with chagrin the carrying out of electric railway schemes in which they played no part. "Surely," they said, "railway engineering is civil engineering; these men are encroaching on our preserves." And now consulting electrical engineers, who have devoted years to the study of electric railway problems, who have read papers on the subject before the learned Societies, who have borne the brunt of the pioneering work, must stand aside whilst civil engineers who have picked up their electrical engineering knowledge as the ironmonger has picked up electric wiring, are entrusted not only with electric railway problems, but with electrical power transmission schemes and other works which the consulting electrical engineer considers his own particular work.

So again in the domain of electric lighting, the architect has largely ousted the consulting engineer in public building and country house installations, and the naval architect draws the consulting engineer's fees for steamship and yacht installations.

Much as we may deplore these facts, it is, as we have already pointed out, of no use to close our eyes to them nor to heap abuse upon the other people and call them by vulgar names. And just as there is no redress in the higher branches of the industry, no machinery by means of which the charlatan and the incompetent may be prevented from posing as electrical experts, so is there none in the manufacturing and contracting branches.

A dynamo and motor manufacturer may, if he choose, make steam or petrol engines, whilst a turbine or engine builder may help to make ends meet by filling his shops with electrical work. No one would think of questioning the right of either to make whatever he liked. When we come to electrical contracting, however, it would appear from a contemporary that there is a demand for exceptional treatment, viz., that any man who styles himself an electrical contractor—and any Dick, Tom, or Harry, be he a farm labourer or a chimney sweep, may do so if he choose—should be able to object to any tradesmen, skilled though he may be, who trades under the style of plumber, gasfitter, or ironmonger, carrying out electric wiring contracts, or even selling electric radiators, lamps or other electrical sundries. This, at any rate, is the logical conclusion of the argument.

That the leading contractors share these views we do not believe. They must know that an ironmonger is as free to start an electrical contracting department as an electrical contractor is to start an ironmongery store or a motor-car garage; and providing that they engage competent men for the work, their competition will be less to be feared than that of the jerry wiring contractor.

What we want to see, and what the Electrical Contractors' Association want to see, and in fact what everybody who has the true interests of the electrical industry at heart desires, is the elimination of cheap and nasty work and the cut-throat competition of the mushroom contractor who is here to-day and gone to-morrow, and who lives a parasitic existence at the expense of honest men. We go further than this, and say that we should like to see some means introduced for the regulation of the industry, means which would make it impossible for any man without adequate training or experience to set up or pose either as an electrical expert or as a contractor.

As, however, there are no such means, nor is there any likelihood of such, all that we can do is to welcome any attempt to control the quality of the work carried out. For this reason we heartily approve the action of the Home Office in attempting to formulate rules, capable of enforcement, which have for their object the improvement of the standard of electrical work in factories and workshops. With the details of these rules we are not at present concerned; with the spirit in which they are conceived we are in sympathy. Such rules will surely prevent the ironmonger, who is no more than an ironmonger, the plumber whose knowledge ends with plumbing, and the gasfitter who does not know the difference between an insulator and an installation, from undertaking electric lighting and power contracts in factories. It will not, however, prevent the competent from doing so, be he called electrical contractor or ironmonger.

Whilst we hear that "the Electrical Contractors' Association is doing all in its power to improve the status of the contractor, and to eliminate the 'grip sack' no account bungler," it, on the other hand, opposes the introduction of regulations which have for their object the enforcement of a certain minimum standard of workmanship. Surely this is a short-sighted policy, for if such regulations, suitably modified, could have a wider application and extend to all electrical work, they might assist in the weeding out of the undesirable element in the electrical contracting ranks.

Let us not ape the trade unionist workman who would say—"this man must not run a wire because he has served his time to running lead pipes," or "that man must not fix an electric radiator because he has not served his time to anything"—rather let us strive by all the means in our power to promote the spread of all the applications of electricity to the service of mankind, and to insist upon sound, honest, and good work, no matter under what label the contractor chooses to work.

## SUNDERLAND TRAMWAY ACCIDENTS.

The double event at Sunderland upon which Col. von Donop has reported to the Board of Trade proves to have been a repetition of the accidents upon which we have commented too often for our peace of mind.

Col. von Donop's report is a model of lucidity and conciseness, and everyone who reads it will agree that he has taken the correct view of the two cases.

The first accident, although luckily it involved no loss of life, was sufficiently serious, several passengers being injured. The car ran down a hill about 300 yards long, at the middle of which the grade is as acute as 1 in 11, and at whose foot there is a curve having a radius of 100 ft. It was a single truck, double-deck car equipped with a hand brake, the Westinghouse form of magnetic wheel and track brake, together with the usual facilities for reversing the motors.

The rails were greasy. The driver possibly did not make the compulsory stop on the brow of the hill; certainly he allowed the car to outrun his control before the steepest part of the hill was reached, and Col. von Donop considers that he then lost his head and did the usual silly and ineffective things with the three brakes, with the net result that the car ran into and off the curve at the rate 30 M.P.H., being saved from over-turning by a convenient stone wall.

For the accident the driver must bear the whole blame, as there is no evidence, except his own statements, that any of the brakes were deranged; indeed, on the contrary, it is reasonably certain that they were in good order.

But it is not our intention to waste time and to obscure the issue by talking of the blameworthiness of this particular man, or of the terrible daily risks which tramway passengers run when they deliver themselves up into the keeping of a man who may be reckless by nature or from drink, who may be incompetent, or who may develop, in the presence of some sudden crisis, either cowardice or panic. These things are all worth discussion in their way, and at the proper time, but for the present we are concerned alone with the query: How are accidents to be avoided in which personality is the mainspring? That is to say, how far can the regular and safe running of a car be rendered independent of the driver? So far as we can see now, utter independence is not in view; but it may be possible—moreover, we believe that it is possible—to reduce tramcar risks far below the present rate. How to do this has been indicated in previous articles, but it is necessary to reiterate beyond weariness before new facts are assimilated by the people most concerned.

First of all, probably most important of all, there should not be more than two brakes on a car, and, if it were possible, it should not be in the motorman's power to reverse the motors.

Secondly, the emergency brake must be connected in no way with the service brake; or the emergency brake and the service brake must be one and the same; and, if there be another, by no possible means must it be able to interfere with the other's working, and the converse must hold as well.

Thirdly, it is desirable that the wheels should not be used as the medium between car and rails for braking purposes. Lastly, the application of any emergency brake pure and simple must involve no difficult or delicate movements, and almost no thought at all on the part of the driver. It must be such that when put into action by an elementary motion, the driver is required to make no adjustments, and, indeed, the power to do so must be taken from him altogether.

When once the emergency brake is on, the driver has shot his last bolt, and he can do nothing either good or bad, but he must be so inspired with confidence in the power of the brake that he will not even be nervous as to the result.

It is by no means essential that this brake should retard the car with great violence, but the rate of deceleration may be carried up to a point of inconvenience without injury to the passengers.

If we were asked what chance there is of tramways adopting new brakes and modifying or discarding the existing ones because there has been a succession of serious accidents in various parts of the country, and those accidents are shown to have been due indirectly to the kind of brakes in use or to the way in which they were mixed up, we should say that local pressure will have to be very strong and very insistent before anything is done; not always because the executive officer is unconvinced or uninterested, but because the board of directors or the tramways committee will not agree to the necessary expenditure, which possibly would be considerable.

It is so much easier and less costly to issue "strict instructions" to motormen, to ply them with rules and regulations, and to educate them in their business more or less sensibly, but it is not a policy which commends itself to the prudent, and it is shaped without taking into consideration that the man who runs open-armed into accidents is untrainable, and we defy the most astute to select any large body of men which will not contain one or many such.

Careful, even elaborate, training of motormen is indispensable, although sometimes it is now dispensed with, and in other cases is treated lightly and with impatience; but all the training in the world will not prevent the kind of driver we have in mind, first of all losing control of his car, and last of all being unable to regain it.

When the driver becomes an automaton there will be no more accidents; and, as he is made to approach nearer to the impossible by taking advantage of mechanical and electrical improvements, so will accidents approach nearer to zero.

**The Boiler-Makers' Dispute.** As we foreshadowed a few weeks ago, the prompt and drastic action of the Employers' Federation has had the effect of settling, at any rate for a time, certain matters in dispute among some sections of the shipbuilding and engineering trades. There can be no doubt that had Armstrong, Whitworth & Co. given way to the handful of caulkers who attempted to get behind the existing agreement, this action of the caulkers would have led to other strikes in the neighbourhood, resulting eventually in dissatisfaction throughout the whole industry. It is satisfactory to learn, therefore, that the result of the ballot is in favour of what is known as the Edinburgh Agreement, the voting being officially given as 11,109 for and 7,553 against, or a

majority of 3,556 out of a total number of votes recorded of 18,662. This number is stated to establish a record.

We understand that the provisional agreement which is to take the place of the terms of settlement of 1898, has now been ratified and signed by Sir Andrew Noble, the president of the Employers' Federation, and by the chairmen and secretaries of the unions concerned, on behalf of the workmen.

We understand also that several additional trades unions connected with the engineering trades have thrown in their lot with the Amalgamated Society, and that the terms of the new agreement will be wider in scope than the famous Terms of Settlement of 1898. The actual terms, however, have not yet been made public.

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**Copper.**

The tendency of the copper market at the present time is all in the direction of limitation of supply. The limitation, in this case will, we are told, not be a matter of holding back stocks but an actual curtailment of production. It will naturally be some little time before a measure of this kind can have a marked effect, and meanwhile prices are keeping fairly steady.

In the course of an exhaustive article on the subject which appeared recently in the *Standard*, the average price of the metal for the period 1900 to 1906 was given as £65, and further particulars given show the price for the preceding 20 years to have been still lower, averaging at about £60. Previous to the early date of these calculations (1881), the differences in the conditions of carriage, the after-effect of European wars, and, above all, the absence of the heavy consumption of the electrical industry, do not admit of profitable comparison between present prices and those then existing. The particulars of this period given by the *Standard* are of interest, however, as showing what heavy fluctuations took place even in the days of small consumption, and practically before the American production, with all its complications of speculative dealing, had any influence on the market. During the Crimean war, copper rose to £126 per ton, and other war prices are quoted showing how thoroughly an artificial factor of this kind upsets the market. It is probable, however, that under present conditions a war, even if it involved a copper-producing country, would have a less marked effect. During the period referred to, the United States was only commencing to produce, and Australia was a negligible quantity. Hence, anything affecting Spain sent the price up at once.

The tendency of the financial Press is to anticipate further depression in prices. The heavy fall has already been responsible for one prominent failure, and the general loss of confidence may lead to further selling. This state of things comes heavily on new ventures which have not long commenced production. Provided, however, that such concerns can last, there should be good prospects for them on the revival. Noticeable among recent returns is that of the Foldal Co., in Norway, as showing what efforts are being made to open up a field, the ore in which has hitherto been considered of too low a grade to be profitably worked. In this case the ore contains a very large quantity of sulphur, and the copper thus becomes of the nature of a by-product, placing the concern in a more favourable position for surviving periods of low prices.

Messrs. Merton's report for September shows a general, though not pronounced, falling off in supplies, Australia being the only exception. From the general tables it appears that the present price has not prevailed since October, 1904. The lengthy period of rise would lead to the conclusion that supply has at last overtaken demand, but it is doubtful if this theory would entirely hold if a trade revival were to occur.

**Advertisement or Article?**

We have always regarded it as of vital importance in the public interest that a very definite line should be drawn between an advertisement and an editorial comment. For the statements contained in the former the advertiser should be entirely responsible; for the latter, the editor. In the old days, when dignity and independence characterised the conduct of most of our great newspapers, there was far less danger of the public being misled through a confusion of the two kinds of published statements.

When some financial and trade organs of a certain class lent themselves to the practice of publishing paid-for reports in their editorial columns, it was a regrettable and most reprehensible sacrificing of independence before the unscrupulous god of commercialism, and it was a practice against which the public had to be warned, by ourselves amongst others.

But when the evil tendency began to reveal itself in the higher walks of journalism, our estimation of some whom we had come to regard as quite above reproach, lessened materially. The write-up advertisements, which appeared in the *Times* headed "Written by a member of the *Times*' staff," or with words to that effect, led us to regard even the apostles of Printing House Square in a new light. When that organ went a step further, and in the pages of its *Engineering Supplement* published advertisement-articles on the Victoria Falls scheme in a manner which was not calculated to protect the gullible prospective investor, we ventured to offer our protest. (See Electrical Review, December 7th, 1906, page 893.)

We now observe that a difficulty has arisen between the *Times* and its advertisers about write-up advertisements, for certain advertisers who have had the temerity to quote as "What the *Times* says" some of these notes prepared by a member of the *Times* advertising staff, have been severely censured by the editors, and have been made to write letters regretting such quotation. The *Times* of October 5th (last Saturday) in publishing these letters makes what comes to us as a very welcome expression of the right feeling in regard to this matter, when it says:—

> **The reprehensible and growing practice of publishing, as though they were editorial comments, paid advertisements which have appeared in the columns of the press, makes it necessary that we should warn the public against this form of misrepresentation. . . . . The editorial staff of the *Times* have no responsibility for such statements, and the reproduction of these advertisements as the opinion of the *Times* is calculated to mislead the public."**

One of the offending parties has written to the *Times*, October 8th, protesting against the editors' statements and saying that the advertisement-articles were written by a member of the *Times* staff, and were thus considered to express the opinion of the *Times*. Now, if there be a misunderstanding on the part of the advertiser, how much more likely it is that the reader will misunderstand!

For the further particulars of the matter we would refer our readers to our contemporary's own pages, but we cannot refrain from remarking that we think the Printing House Square authorities are largely to blame for the action of the offending advertiser, because they have allowed advertisements to appear bearing the *Times* advertisement hall-mark, namely, the statement that the advertisements have been written by a member of their own staff. It would be showing a better regard for the interests of the public if the practice were abandoned.

May we also add that it would raise the *Times* in everybody's estimation once again if they were to abandon the practice of accepting payment for reports of company meetings appearing in the *Financial and Commercial Supplement*.

We are quite aware that there is a statement printed to the effect that these particular meetings are published as advertisements, but that is not at all a satisfactory position of things from an independent point of view.

## THE LOSSES IN HEAVY ALTERNATING CURRENT CABLES.

Some interesting experiments on the increased resistance offered to alternating currents by cables of large section are described by Herr E. Stirnimann in the *Elektrotechnische Zeitschrift*. They were made at the instance of the electrical engineer of Lucerne, before laying some new cables of increased section. Single lead-covered cables without iron armouring of 400, 250, 200, 150 and 100 sq. mm. section were available. They were laid in the ground, and where they crossed roads, &c., the lead and return cables were always laid in the same cast-iron pipe. Simultaneous measurements of the voltages at the two ends of the cable were made with the ordinary working currents by means of carefully calibrated hot-wire instruments. The accuracy obtainable by this means is not great, but, as will seen, it is quite sufficient to indicate that a large increase in resistance occurs.

The average of a large number of readings at about 140 volts and 50 cycles was taken in each case, with the following results :—

| Area of cable. Sq. mm. | Length of cable. Metres. | Approximate current used. | Calculated resistance to direct current = $2 \times \frac{17{\cdot}5 \times \text{length of single cable in kilometres}}{\text{area of conductor.}}$ | Apparent resistance to alternating current. | Ratio. $\frac{\text{Apparent A.C. resistance}}{\text{D.C. resistance.}}$ |
|---|---|---|---|---|---|
| 100 | 25 | 100 | ·009 | ·0099 | 1·1 |
| 150 | 90 | 72 | ·0217 | ·0263 | 1·21 |
| 200 | 74 | 133 | ·013 | ·0226 | 1·74 |
| 250 | 150 | 120 | ·021 | ·0436 | 2·08 |
| 400 | 47 | 138 | ·00412 | ·0099 | 2·4* |
| 400 | 47 | 155 | ·00412 | ·0108 | 2·62† |
| 400 | 81 | 102 | ·0071 | ·0148 | 2·1 |

* Using separate voltmeters. † Using a single voltmeter and pilot wires.

These large additional resistances were quite unexpected by the experimenters, and cannot be explained by the ordinary skin effect. With a view to eliminating errors due to variations in the conductivity of the copper, and to get a direct comparison between the direct and alternating current resistances, a further set of tests was made on short lengths of cable stretched across the laboratory. The lead and return were bound closely together all along, and soldered to one another at one end. A direct current was first sent round the loop from an accumulator, and the current and voltage difference were measured with hot-wire instruments. The results agreed closely with the calculated resistances in all cases. An alternating current was then sent round the loop from a low pressure transformer secondary, and the voltage drop and current were again measured with the same instruments. The results reduced to 1 km. of single cable were as follows :—

| Section of cable in sq. mm. | Direct current resistance per km. | Apparent resistance to 50 ~ alternating current. | Ratio. $\frac{\text{Apparent A.C. resist.}}{\text{D.C. resistance.}}$ |
|---|---|---|---|
| 50 | ·705 ω | ·815 ω | 1·16 |
| 100 | ·372 ω | ·525 ω | 1·41 |
| 150 | ·246 ω | ·398 ω | 1·62 |
| 200 | ·175 ω | ·382 ω | 2·18 |
| 400 | ·096 ω | ·302 ω | 3·15 |

The apparent A.C. resistance is higher when measured in this way because the self-induction term becomes important. It is, however, possible to calculate the self-induction of a plain loop, such as was used in the tests, with fair accuracy, and when this is done and the value is combined with the true (D.C.) resistance of the cable, it is found insufficient to account for the large increase in apparent resistance shown by the test. As a check on this point, the author also experimented on a special two-core cable of the section shown in fig. 1, having, therefore, a very low self-induction. The cores had a section of 200 sq. mm. each, and the value of the ratio of apparent A.C. resistance to true D.C. resistance still came out as 1·85. Finally, a concentric cable of 200 sq. mm. in each conductor was tried, and here, although the ratio was much lower (1·05), it still exceeded unity.

The author, therefore, came to the conclusion that, although the self-induction might account for part of the increased apparent resistance, some additional and somewhat erratic cause must be present as well. This cause he believes can be fully explained as follows :—Consider an ordinary stranded cable. It consists of a central wire, around which one or more layers of similar wire are laid spirally. Fig. 2 shows the position occupied by a single lap of one wire of, say, the outermost layer. This lap commences at A, and after spiralling through an angle of $2\pi$, arrives at B. Beside this wire, and in contact with it, are a number of other strands between A and B. The current has, therefore, two paths open to it—one ($J_2$) along the wire from A, past C to B, and the other ($J_1$) directly from A to B across the strands. The first path has resistance due to the

Fig. 1.

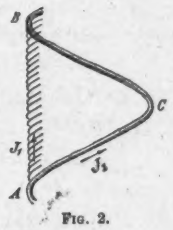



Fig. 2.

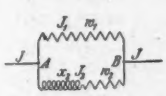



Fig. 3.

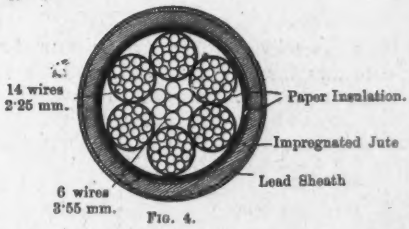



Fig. 4.

The Losses in Heavy Alternating-Current Cables.

specific resistance of the copper, and inductance due to the continuous spiral formed by the strand. The second path has only ohmic resistance, consisting chiefly of the contact resistances from wire to wire. It is, in fact, a simple case of impedance and resistance in parallel, as shown in fig. 3. For this case

$$J_1 w_1 = \overline{J_2 w_2 + J_2 x_2} = J z,$$

say $J_2 w_2$ is the ohmic drop in the strand, and this, combined vectorially with the inductive drop $J_2 x_2$, gives the actual drop between A and B. This drop must be equal to $J_1 w_1$, the drop in the parallel path from A to B. It is impossible to determine the values of $J_1$ and $J_2$, and probably the handling of a cable (unwinding it from the drum, &c.) by causing the strands to separate slightly, altogether alters the proportions, but a greater or less increase in apparent resistance evidently occurs from this cause. The central wire has no inductance of this nature, but the further the strands are from the centre, the greater will be the effect, so that the factor will be greater for large diameter cables than for small, as was found to be the case experimentally. No definite numerical values for the ratio of apparent resistance to true resistance can be given, as the arrangement of the strands and the make of the cable generally enter into the matter too much. For instance, in the case of two cables of different makes, but of 400 sq. mm. section each, the ratio obtained experimentally was 6 in one case and 3·15 in the other, the only difference between the two being that the former was lead-covered and was made up of concentric layers of wires, whilst the latter was rubber-covered, and, in order to make it more flexible, consisted of several small cables stranded together.

In order to check this result, a special 400-mm. cable was made up as shown in fig. 4, and a length of 250 metres showed the following results :—

Resistance to direct current (calculated allowing for the increased length owing to the lay of the insulated cables) = ·01175 ohm. Resistance to alternating current of 50 cycles (measured by loading the cable and noting the voltages at

the two ends) = ·012, giving a ratio of only 1·02, which confirms the above explanation. When the cable was short-circuited, the apparent resistance (including inductance) was ·0284 ohm, giving a ratio of 2·42.

The separate component cables had sections of 56 sq. mm., and the central one 67 sq. mm.

The conclusions arrived at by the author are that for normal alternating-current systems ordinary cables can be safely used up to cross-sections of 100 sq. mm., but above this the cables should be sub-divided into a number of segmental or circular cables, insulated lightly from one another, and stranded together, and of not more 70 sq. mm. section each.

Specifications for alternating-current cables should also contain a clause fixing the conductivity for alternating currents at, say, 95 per cent. for 50 cycles, and 98 per cent. for 30 cycles or less—the latter being the ordinary direct-current specification.

## A METHOD OF TESTING D.C. NETWORKS FOR INSULATION RESISTANCE DURING WORKING.

By DANIEL SHIRT.

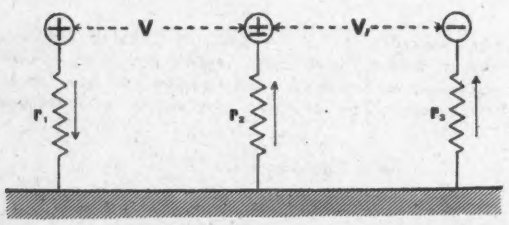
The necessity of having a quick and reliable means of obtaining the I.R. of "live" networks has been generally recognised. Mr. Raphael, in his well-known work, has described various interesting methods of doing this; and it would appear that "the last word," almost, had been said on this important subject.

The following test has not, however, the writer believes, been described, hitherto, in technical works on the subject, although it embodies a well-known principle.

It may be applied with advantage to the "neutral" of a three or a five-wire system, because the earth connection need not be interrupted.

It is customary in, perhaps, most generating stations to make the resistance of the neutral earth connection as small as possible, but to provide some means of introducing a known resistance, either by means of a switch, which

Fig. 1.



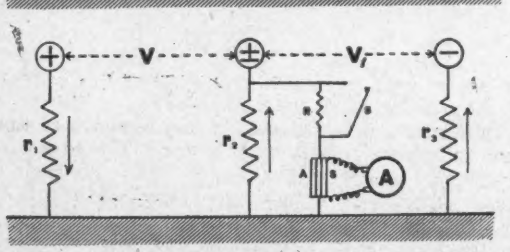




Fig. 2.

normally short-circuits it, or by means of a rheostat; so that, in the event of a fault occurring on one of the "outers," the "leakage" current may be controlled. Fig. 2 illustrates, diagrammatically, one arrangement of this kind.

The test may be varied in several ways, but one will suffice for illustration:—

Note leakage current ($C_1$) through the earth connection, when it has a known resistance of $R_1$ ohms, say; then vary the resistance to $R_2$ ohms, say, noting the new value of the current ($C_2$).

The insulation of the system to earth, in ohms, may then be calculated from the formula—

$$\frac{C_2 R_2 - C_1 R_1}{C_1 - C_2}. \quad \ldots \quad \ldots \quad (1)$$

The absolute value of the current in an instrument whose readings are proportional to the currents passing through it will be $= c \times d$, where $c$ is the known "constant" of the instrument, and $d$ the deflection. One constant enters into each term of the numerator and denominator of (1), so that it may be written—

$$\frac{d_2 R_2 - d_1 R_1}{d_1 - d_2}. \quad \ldots \quad \ldots \quad (2)$$

This shows that any instrument fulfilling the above condition may be used; yet a moving-coil type is to be preferred, because its resistance (without its shunt) being high, it may be connected as a shunt across any convenient portion of $R_1$ without sensibly affecting the resistance of that portion. One is thus able to secure a suitably large deflection, when, perhaps, the readings on an ampere scale are too small for observation.

$R_1$ may conveniently represent the normal resistance of the earth connection, and may in some cases be so small, as compared with the I.R. of the system, that the formula $d_2 R_2 / (d_1 - d_2)$ may be employed, and will give a sufficiently accurate result for practical purposes. If $R_2$ can be increased until $C_2 = \frac{1}{2} C_1$, formula (2) reduces to: $R_2 = 2 R_1$.

In the following proof of the formula (2), given above, it is assumed that the test is taken from the neutral main of a three-wire system; but it may be easily shown that the formula is true for any network which is definitely earthed at one point only, and may be applied to either the positive, negative, or intermediate bus-bars:—

Let $r_1$, $r_2$ and $r_3$ (fig. 1) represent the resistances to earth of the positive, neutral, and negative mains, respectively, in a three-wire network, $c_1$, $c_2$ and $c_3$ the corresponding currents, and V and $V_1$ the D.P. between the mains as shown. Then—

$$\begin{aligned} c_1 r_1 + c_2 r_2 - V &= 0, \\ c_3 r_3 - c_2 r_2 - V_1 &= 0, \\ c_1 - c_2 - c_3 &= 0. \end{aligned}$$

From this we obtain—

$$c_2 = \frac{V r_3 - V_1 r_1}{r_1 r_2 + r_1 r_3 + r_2 r_3}, \quad \ldots \quad (3)$$

and when $V = V_1$—

$$c_2 = \frac{V (r_3 - r_1)}{r_1 r_2 + r_1 r_3 + r_2 r_3}. \quad \ldots \quad (4)$$

The sign of $c_2$ will depend upon the relative values of $r_1$ and $r_3$.

If we connect the neutral bus-bar to earth through a resistance of $R_1$ ohms, the total current between this main and earth will become—

$$\frac{V (r_3 - r_1)}{\frac{r_1 r_2 R_1}{r_2 + R_1} + r_1 r_3 + \frac{r_2 r_3 R_1}{r_2 + R_1}} \text{ amperes,}$$

and the current passing through the earth connection will be—

$$C_1 = \frac{V (r_3 - r_1)}{\frac{r_1 r_2 R_1}{r_2 + R_1} + r_1 r_3 + \frac{r_2 r_3 R_1}{r_2 + R_1}} \times \frac{r_2}{r_2 + R_1}$$

$$= \frac{V (r_2 r_3 - r_1 r_2)}{R_1 (r_1 r_2 + r_1 r_3 + r_2 r_3) + r_1 r_2 r_3}. \quad (5)$$

Similarly, if $R_2$ ohms be substituted for $R_1$, the current through the earth connection will be—

$$C_2 = \frac{V (r_2 r_2 - r_1 r_2)}{R_2 (r_1 r_2 + r_1 r_3 + r_2 r_3) + r_1 r_2 r_3}. \quad (6)$$

Dividing (5) by (6)—

$$\frac{C_1}{C_2} = \frac{d_1}{d_2} = \frac{R_2 (r_1 r_2 + r_1 r_3 + r_2 r_3) + r_1 r_2 r_3}{R_1 (r_1 r_2 + r_1 r_3 + r_2 r_3) + r_1 r_2 r_3},$$

and reducing, we obtain finally—

$$\frac{C_2 R_2 - C_1 R_1}{C_1 - C_2} = \frac{d_2 R_2 - d_1 R_1}{d_1 - d_2} = \frac{1}{\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3}}.$$

That is = the insulation of the system to earth in ohms.

## LONDON STREET TRAFFIC REGULATION.

Some two years ago the proper utilisation of circuses at street intersections for facilitating continuity and speed of traffic was urged in the *Times* (Engineering Supplement) by Mr. W. H. Booth, and considerable publicity was given to the question. Mr. Booth gave credit for the original idea to Mr. Chas. Rennick, of Melbourne, Australia, with whom he had discussed the matter about the year 1880. He brought

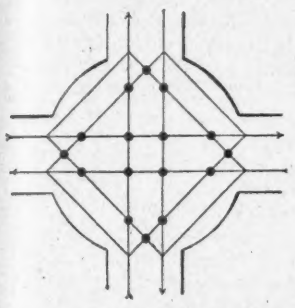


Fig. 1.—Typical Circus, showing Points of Intersection of Lines of Traffic.

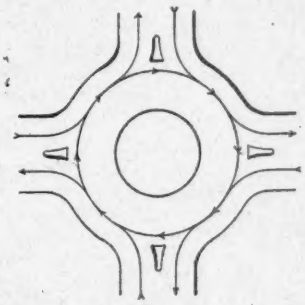


Fig. 2.—Typical Circus with Gyratory Regulation.

it up in the *Times* as a rational and economical alternative to the extravagant proposal to spend about thirty millions sterling on new streets which would really accomplish very little to help traffic along existing thoroughfares. The circus idea is undoubtedly ingenious, and at a meeting on Thursday, October 3rd, of the Civil and Mechanical Engineers Society, Mr. W. N. Twelvetrees gave an address as President, in which he not only advocated the system, but also gave illustrations of various London circuses, showing how the gyratory movement of traffic would take place, and how it would obviate the terrible nuisance of intersecting streams. We reproduce a few of the diagrams to show how the system may be arranged. Mr. Booth, we understand, has stated that tramways may be automatically worked on the circus system to the great simplification of track work and of overhead work, not to mention the public safety, which is

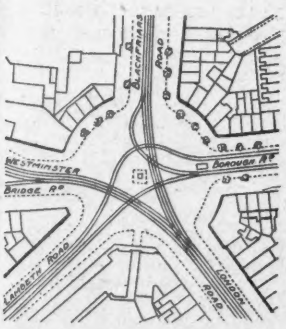



Fig. 3.—Tramways at present passing through St. George's Circus, London, S.E.

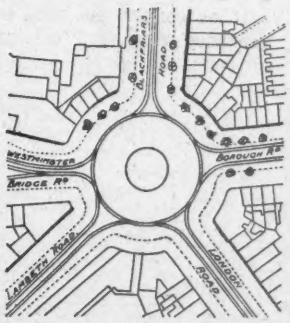



Fig. 4.—Tramways through St. George's Circus with Gyratory Regulation.

not a little jeopardised by the extravagant system of fortuitous intersection to be seen, say, at St. George's Circus.

Mr. Twelvetrees says that Mr. Holroyd Smith brought the subject before the London County Council 10 years ago. It was before the Council again about two years ago, but expenditure, not economy, was then fashionable, and the L.C.C. could not, or perhaps would not, see how the system could work. We sincerely hope that Mr. Twelvetrees will be more successful in his efforts of to-day. We have heard of the system of gyratory traffic being condemned, but the person who condemned it happened, unfortunately, to be engaged in the manufacture of special track work such as forms so expensive a feature at all the circus intersections of London's tramways.

The improvement and enlargement of some existing circuses might be necessary, and even new circuses might be required at some street intersections at present simple, but the cost of all the changes would be a mere nothing, as compared with the cost of new streets.

It is very easy to have a trial made of the gyratory system, for all that is necessary is to put up a temporary barrier to close up the middle area of a circus by a rough circle. Traffic would thus be compelled to go round, and the police would see that it went round with the clock. This would prove the system. It is almost hopeless, of course, to expect a public body to attempt anything suggested from outside, or already the system would surely have been given a fair test. But the L.C.C. of to-day is not constituted as it was two years ago. Does the reorganised body cherish the desire to substitute an outlay of pence where it was proposed to spend pounds? If not, is there any means of having the system of gyratory traffic tried and proved, independently of the Council and its advisers?

It ought to be clearly understood that an actual circus about the point of street intersection is by no means absolutely necessary to the carrying out of the gyratory principle. This has been pointed out by Mr. Booth, who states that any block of buildings may be assumed as the central area or plateau of a circus, so long as the traffic in the rectangle of streets around that block of buildings is compelled to traverse such streets always clockwise. It is a question for consideration whether a "circus" need have a blank central plateau. It might be occupied by a building. But the central space, if properly filled with a fountain and a grass plot, should prove a welcome relief to the eye; or there might be a central bungalow building with post office, telephones and other public utilities.

We fear the system is, however, so easy and simple of understanding that it will resemble the prophet's Jordan rather than the Assyrian's Pharpar, and will not be acceptable—costing too little to carry into effect.

## CORRESPONDENCE.

*Letters received by us after* **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

### Lake Constance Telephone Cable.

In No. 1,548 of the Electrical Review, page 122, dated July 26th, there is an article on "Telephone Cables" which also mentions the Pupin cable recently laid across Lake Constance, and in which it is stated that from the success in laying this cable, no conclusions can be drawn as to the practical value of the Pupin theory.

Referring to this statement, it may be said that this was not the purpose of laying the cable. The importance of the Pupin system has been clearly shown on many aerial lines and cables of considerable length, so that, in order to prove the value of the system, it was not necessary to lay the cable across the Lake Constance, which has a length of 12 km. only. The technical value of laying submarine cables lies in the proof that it is possible to construct and lay a useful submarine cable with fixed Pupin coils; furthermore, in the fact that a lead-covered cable, the conductors of which are insulated with paper, with a stiffening spiral over the core, is capable of standing a water pressure of 25 atmospheres and even more, without injury. This is a very important point, which cannot be neglected in laying submarine cables for telephone purposes. Only from this point of view can the laying of the cable across the Lake Constance be valued, and the article referred to above

clearly states "that it is impossible to manufacture such a cable and to lay it under comparatively easy conditions." Incidentally, it may be said that there can be no question of "comparatively easy conditions." On the contrary, the conditions for laying a telephone cable were very unfavourable, for, apart from fixing the coils to the cable and laying the same—it was not only necessary to overcome a depth of 250 m., but to connect 7 speaking circuits, *i.e.*, 14 telephone cores, into one cable. The great importance of the cable laid across the Lake Constance lies in the fact that these purely technical difficulties have been successfully overcome.

Thus the object of this cable has nothing to do with that intimated in the article in question, but the laying of the same can only be regarded as a successful *preliminary study* for larger and more important tests, for instance, for laying a telephone cable with Pupin coils between England and Germany. After the success achieved with the cable laid across the Lake Constance, one need no longer deter from further experiments with long submarine cables with Pupin coils.

**Siemens & Halske.**

*September 27th.*

[We have much pleasure in publishing Messrs. Siemens and Halske's communication. We have no desire to underrate the excellent pioneer work carried out by the firm in the matter in question, but it would be a subject for regret, we think, if the notice given to the experiment should lead the public to conclude that the problem is solved, and that a telephone cable of the type in question could now be laid between England and Germany with something more than the probability of success. If such a cable were proposed to be made and laid, it should be made clear that it would be experimental only—*i.e.*, that the money expended on it could not be looked on as a safe investment. We should welcome the laying of the cable as an experiment, and should rejoice if it proved a success, but we should hesitate to put any capital into the undertaking except as a donation towards an interesting and valuable trial.—Eds. Elec. Rev.]

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### Long Wheel Base Trucks.

On page 564 you report Mr. Acland's reply referring to the Nuremburg trucks, without my correction made at the time.

Simpson & Park's patent radial trucks which we have built, differ entirely from the trucks at Nuremburg, and are the first to be built on the principle employed.

There was only one pivotal centre, viz., in the centre of the four-wheel car radial truck frame, at Nuremburg, whereas Simpson & Park's trucks being designed on the bogie principle, have two pivotal centres, and these are placed over the centre of each axle. It is a bogie car, with only one axle to each bogie, and with the differential gear on each axle is entirely novel in tramway rolling stock.

**Henry Mozley.**

Burnley, *October 7th*, 1907.

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### "Daily Mail" Wireless Telegraphy.

In the *Daily Mail* for October 3rd, page 7, there is a very valuable article on "Wireless Telegraphy."

There are one or two things in the articles which I cannot understand, and which none of my books of reference give me any information about; probably it is because, being only a young student in these matters, my knowledge is very limited. I shall be greatly obliged if you can help a student who is anxious to thoroughly understand what he reads about.

"I was enabled also to inspect the entire signalling apparatus, from dynamo to triatics."

What are *triatics?*

"The greater 'conization' of the atmosphere by day has had the effect of impeding the ether vibration."

What is *conization?*

I have made endeavours in all directions where I was likely to get information to clear up these points, and my failure to do so must be my apology for asking for assistance.

Is there any cheap book published on wireless telegraphy which is not so entirely technical that it will be understandable by the man in the street?

**Alf. Gardiner.**

*October 7th*, 1907.

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### Appointment of Mains Assistant at South Shields.

I would like to call your readers' attention to another instance of municipal thoughtlessness. In your personal column of the 4th inst. you state that Mr. Edgar, late of Edinburgh, has been appointed to the post. This statement is very misleading, as it does not explain that Mr. Edgar was in the employ of the South Shields Electricity Works during the time the above post was advertised. I do not wish to infer that Mr. Edgar is not a suitable man for the post; quite the reverse. I do think, however, that a little consideration on the part of the Electrical Committee would have saved many from wasting time and money in sending in an application. It would be interesting to know the names of those who were "short listed."

**Not a Disappointed Applicant.**

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### Electric Heating.

I have read the articles in your last issue regarding electric heating, &c., with much interest.

Within the last year I had occasion to ask a local contractor the cost of wiring for heating a dwelling-house in this district, already wired for electric light, and was informed that it would cost about five pounds (£5) per point.

Comment on this charge would be superfluous, but I think you will agree that it explains to a large extent the reluctance of the ordinary householder to investigate further the possibilities of electric heating and lighting.

**Nemo.**

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### Metal Core Flame Carbons.

Under the above heading, on page 499 of your issue of 27th ult., I read a statement referring to the above class of carbons, which certainly does not coincide with the facts as established by the users of properly made carbons.

I have had experience, both direct and through the customers of the company with which I am connected, of many millions of the Excello patent carbons, constructed in the famous Conradty works, fitted with a metal core in a separate core hole, and have only on one or two occasions found single carbons with a loose metal core, and in these cases the trouble has been due to the failure of an individual workman to properly crimp the metal core, and not to the heating of the same as suggested in your note.

I have tried other makes of metal-cored carbons, which have been sold as not infringing the patents used in the construction of Excello carbons, and have found in some makes the number of defective carbons ranging as high as 18 per cent. in 1,000 samples tested.

The separation of the metal from the salted core, possesses several advantages, not the least among which are high luminous efficiency, regularity of colouration (both in use and after storage), and low constant resistance with consequent correct maintenance of the arc of even length and correct height and temperature.

**Justus Eck.**

London, W., *October 8th*, 1907.

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Correction.—We regret that the name of Mr. H. Stafford Hatfield was incorrectly printed as "Natfield" under his letter on "The Improvement of the Small Power Load" in our last issue.

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Address Wanted.—A correspondent wants to know the address of the makers of the Halax celluloid accumulator cases.

## STEAM v. ELECTRIC LOCOMOTIVES.

At a meeting of the New York Railroad Club on Friday, September 20th, a paper on the "Steam Locomotive *v.* Electric Locomotive" was read by Mr. Max Tolz, general manager of the Manistree and Grand Rapids Railroad. For the following extracts from the paper, and for the report of the discussion, we are indebted to our contemporary the *Street Railway Journal* received by this week's mail :—

At the meeting of the American Institute of Electrical Engineers, New York, January 25th, 1907, a paper on "The Substitution of the Electric Motor for the Steam Locomotive" was presented by Lewis B. Stillwell and Henry St. Clair Putnam. According to their estimate, if all the railways of the United States were to-day operated by electricity, the aggregate cost of operation, which in 1905 amounted in round numbers to $1,400,000,000, would be reduced by about $250,000,000. This bold statement seems to have scared some editors of eastern railroad periodicals, so much so that one of them at once propounded the question: "What will be done with steam locomotives if electricity should become the motive power on the steam railroads within the next few years?" In such an event he fears that large numbers of steam locomotives would be thrown out of service and a vast amount of invested capital lie idle.

It is not the intention of the writer to discuss all the details of the above-named paper, but he will confine himself only to the items pertaining to steam locomotives, viz., repairs and renewals of locomotives, engines and roundhouse men, fuel for locomotives, and water supply for locomotives.

Incidentally, it may be stated here that the writer does not agree with the statements made by the two gentlemen relating to maintenance of way estimates in which the items of cost of renewals of rails, ties, bridges and culverts have been reduced about $21,000,000, and for repairs and renewals of building and fixtures about $13,500,000. It has been found that the construction of the track and the roadway must not alone be fully as good, but better, when operating upon them an electric railroad, and more pains and labour will be necessary to keep up the repairs.

The writer contends that the steam locomotive properly improved is far more economical than the electric locomotive, even taking it for granted that a kilowatt-hour of electrical power could be furnished at the low figure of 0·6 cent at the bus-bars, and at 0·8 cent effective for traction as named by Messrs. Stillwell and Putnam, who further state that a horse-power effective for traction will cost therefore 0·6 cent, of which 0·35 cent is for fuel when coal of 1,400 B.TH.U. per pound costs $3 per ton of 2,240 lb., and 0·25 cent is for other supplies, labour and maintenance equipment.

To analyse these statements it will be necessary first to establish the cost of an effective locomotive horse-power to be hereafter called draw-bar horse-power of the locomotive. From the figures given by the authors, who estimate that, for the operation of the entire freight and passenger service of the United States, as existing in 1905, the aggregate energy required at the bus-bars of power houses would approximate 12,500,000,000 KW.-hours per annum. This, converted into horse-power, would give 16,625,000,000 H.P.-hours. To check this statement, the writer refers to the report of the Interstate Commerce Commission of 1904. The locomotives in service were, in round numbers, 47,000. The average freight locomotive is actually on the road not more than 6 hours in each 24-hour period, and the same figure is approximately correct for the passenger locomotives. Assuming that each locomotive will continuously develop during the six hours' work 250 draw-bar H.P. (a very low estimate), the total number of H.P.-hours per annum will then be nearly 26,000,000,000. In the reports of the Interstate Commerce Commission, 1905, it is also stated that nearly $156,500,000 was expended on fuel for locomotives. Dividing this item by the total H.P.-hours per annum would give a cost of 0·6 cent for fuel per draw-bar H.P.-hour compared with the estimated cost of fuel of 0·35 cent as above mentioned when assuming the railroads are operated electrically. This former figure is practically correct, because we know that in the average a steam locomotive will use 28 lb. of steam per H.P.-hour. The average coal used in a locomotive boiler will evaporate about 6 lb. of water, which would necessitate 4½ lb. of coal per H.P.-hour, at $3 per ton of 2,240 lb., and will amount to 0·6 cent per H.P.-hour. This, indeed, shows that more fuel per H.P.-hour is being consumed in locomotives than in modern stationary plants which furnish power for electrical operation.

But is it fair to compare the up-to-date power plant with the average locomotive? About 60 per cent. of the locomotives now in use were built over 15 years ago. The reasoning for comparison should be made upon the basis of the latest type of locomotives, and therefore the writer refers to the locomotive tests made during the World's Fair at St. Louis, which have established the fact that the coal consumption per draw-bar H.P.-hour was considerably less than 2½ lb. Yet properly to dissect the economy in the locomotives, it will be in place to call attention to the fact that each locomotive has one most economical speed limit, or, in other words, that on a given grade, at a certain speed with a defined maximum load the locomotive will turn out the most work at the lowest cost.

The question of the most economical work to be obtained from any locomotive seems to be not fully understood, because the management of roads generally have prescribed the policy of big train tonnage to the detriment of the service. The mechanical departments' recommendations regarding smaller tonnage and higher speeds are often not accepted, and in consequence it will be found that the locomotives do not work to the best advantage.

The basis of later calculation of the cost per draw-bar H.P. will be made from the figures obtained from the Mallet compound engine, in which the best performance is made at nine miles per hour on 2·2 per cent. grade, working with saturated steam, while with superheated steam it is at a speed a little over 10 miles. Taking the first case, the increase of coal consumption over five miles per hour is only 8 per cent., while the increase in ton-mile hours over five miles is 72 per cent. At this speed the coal consumption per draw-bar H.P.-hour is 2·6 lb.

This is a remarkable showing, but we should not be satisfied with the result obtained in this type of locomotive because more economy can be derived from further improvements, especially in superheating.

During the last two years a successful attempt has been made to improve the steam by superheating, which not only gives steam economy, but also saves the coal pile. Mr. Vaughan, of the Canadian Pacific, in his recent paper on superheated steam locomotives read before the American Society of Mechanical Engineers at Indianapolis, reported an average saving of coal of 15 per cent. for the superheated over the saturated steam locomotive, although in European practice these results average over 25 per cent.

Great credit should be given Herr Schmidt, who for the last ten years has done excellent work in this line in Europe, and the writer is fully convinced that in a few years, after the locomotive superheater has been adapted to and tried in our railroad practice, a greater economy in coal than has been shown so far will be recorded. Consequently, the saving in coal by the use of superheated instead of saturated steam will be assumed to be 20 per cent.

Higher superheat should, and must, be used to derive the advantages from superheated steam. This has been shown in the locomotive of the Canadian Pacific, which was equipped with the first Schmidt smoke-box superheater in 1901. Many locomotives of the Belgian State Railway are equipped with the Schmidt superheater, and according to the statement of Monsieur Flamme, general superintendent of motive power, the saving of coal amounts to over 25 per cent.

Next to the saving in coal, by the use of superheated steam, comes the increase in the capacity of the boiler and the saving of feed water, which averages more than 30 per cent. This feature is very important because in many instances a water station with exceptionally bad water can be abandoned or used for emergency. Boiler washings will be reduced and cost of water supply decreased proportionally.

According to the statistics of railways for 1904, compiled by the Interstate Commerce Commission, the repairs and renewals of locomotives amounted to $115,000,000, while for engine and roundhouse men about $130,450,000 was expended. With improvements to boiler and to feed water apparatus as outlined above, these items, in the opinion of the writer, could be reduced 30 per cent., which would make a saving over $73,635,000.

Although it is maintained that the work of the engine crew has been increased, due to the magnitude of the latest type of machine, so much that the limit of its capacity has been reached, it is believed, that by applying the improvements, which are possible from a mechanical engineering standpoint, the work of the crew will be decreased in many respects. For instance, in superheating the steam, less coal will be handled by the fireman, and, in connection with perfect lubrication, the work of the steam in the cylinders will be greatly improved. There should be no blown out cylinder heads due to accumulation of water. Better and quicker starting of the train will be attained. Failures through non-steaming will be avoided by heating the feed water. There will be fewer leaky flues and fire boxes, and the hard work of the fireman can be reduced considerably by a perfect stoker. Roundhouse labour on the boiler will be minimised, fire boxes and flues will last longer, and last, but not least, the curse of uncleaniness, due to locomotive smoke, will be abated under conditions of perfect combustion in the fire box.

The saving in coal can be estimated at 20 per cent. by superheating, at 20 per cent. by feed water heating and at 5 per cent. by perfect combustion, an aggregate of 39·2 per cent.; the saving in locomotive repairs, 30 per cent.; the saving in water supply for locomotives, 30 per cent.

The first proposition which naturally presents itself is to deduct from the items of the 1904 report of the Interstate Commerce Commission these various percentages, which will give the following results :—

| | |
|---|---|
| 30 per cent. of $130,500,000 for engine and roundhouse men (2) ... ... ... ... ... ... ... | $39,150,000 |
| 39·2 per cent. of $156,500,000 for locomotive fuel (3)... | 61,348,000 |
| 30 per cent. of $9,150,000 for water supply (4) ... | 2,745,000 |
| Total saving per year ... ... ... ... | $103,243,000 |

In this, no account has been made for reduction of repairs and renewals.

The second proposition, assuming that all existing locomotives are of the latest types, using, instead of 4½ lb., only 2·6 lb. of coal per draw-bar H.P., and are equipped with the saving devices, will resolve itself into the following :—

| | |
|---|---|
| 42·2 per cent. less coal for modern equipment ... | $66,040,000 |
| 39·2 per cent. of $90,460,000 (Item 3) about ... ... ($90,460,000, $66,040,000, $156,500,000, total Item 3) | 35,460,000 |
| 30 per cent. of $115,000,000 (Item 1) ... ... ... | |
| 30 per cent. of $130,500,000 (Item 2) ... ... ... | 73,635,000 |
| 30 per cent. of $9,150,000 (Item 4) ... ... ... | 2,745,000 |
| Total saving per year ... ... ... ... | $177,880,000 |

It is estimated that the three improvements—viz., superheater, feed water heater and smoke consumer or stoker, can be added at a cost of less than $4,000 per locomotive, which will make a total expenditure of $188,000,000 for 47,000 locomotives. According to proposition, this amount would be repaid within 22 months and 12·5 months respectively from the saving.

It is proper to repeat the statement made by Messrs. Stillwell and Putnam relative to the reduction of the four items referred to when all roads are electrically operated. They assumed a saving of—

70 per cent. in Item 1—Repairs and renewals of locomotives;
50 per cent. in Item 2—Engine and roundhouse men;
50 per cent. in Item 3—Fuel for locomotives, and
100 per cent. in Item 4—Water supply for locomotives.

Accordingly, the savings would be as follows:—

| | | |
|---|---|---|
| Item 1—70 per cent. of | $115,000,000 ... ... ... | $80,500,000 |
| Item 2—50 per cent. of | 130,500,000 ... ... ... | 64,860,000 |
| Item 3—50 per cent. of | 156,500,000 ... ... ... | 78,250,000 |
| Item 4—100 per cent. of | 9,148,000 ... ... ... | 9,148,000 |
| A total of | ... ... ... ... ... | $232,758,000 |

This, indeed, looks very attractive, but the writer leaves the criticism of these assumed figures to his brother engineers.

The amount of capital which must be expended to obtain these doubtful results can hardly be imagined. A conservative estimate would be several billions of dollars. Although the estimated saving by an electrical equipment might warrant such an immense expenditure, the improvement of the steam locomotive offers like inducements. It has been the boast of the advocates of railroad electrification that with an electric locomotive, double the trailing tonnage can be hauled at double the speed of the present steam locomotive. The writer begs to state that the steam locomotive of to-day (and not the most powerful one yet built) takes 800 tons singly and 1,600 tons doubly over a mountain grade of 2·2 per cent. with a speed of 10 miles per hour.

The electric locomotive, either in single or multiple units, has its place in big terminals and in tunnels, but it cannot in its present development replace the steam locomotive for trunk-line service. The writer has investigated some of the greatest water powers in the Rockies and in the Cascades, and he ventures to say that none of them can deliver electrical power per draw-bar horse-power for less than 5 cents. Another feature over which most enthusiasts of electrification stumble is the high power factor which is assumed. If electrically operated to-day, the load factor would not exceed 48 per cent. on three typical American railroads—the Great Northern, Northern Pacific and Canadian Pacific. These are facts as Daniel Webster once said, which can invariably be proved, and it will, therefore, be a little time yet before our old standby, the steam locomotive, will be relegated to the scrap heap, if our fraternity will assist in making this old friend of ours what it should be.

### Discussion.

The discussion was opened by William McClellan, consulting engineer of New York City. He referred first to superheaters, saying that his experience with them in connection with stationary boilers had convinced him that they formed the most troublesome part of the boiler plant. Superheaters, like other improvements, would have to go through a long course of experiments before they could be successfully operated on the average road engine. He could not understand why the cost of maintenance of the locomotive should be so much reduced by the superheater as shown in the paper because a superheater was usually expensive to maintain. As to the general subject of the electric locomotive, he felt that the performances already on record were a pretty good defence. The cost of the change to the later motive power certainly was very great, and the electrical engineer who admitted that fact did more good to the cause than one who did not. The cost should be compared not with what the steam road now has, but what it would cost to supply the service by steam which could be given by electricity, viz., a half-hour service, brilliantly-lighted cars, &c. Mr. McClellan admitted with regret that comparative costs of operation were very hard to obtain, especially such items as the cost of fuel and water station, ash-pits, repairs, &c. It seemed that on an average about 15 per cent. of the general repairs of steam locomotives were due to the boiler, but even this factor was not universal. The only way that such costs could be obtained would be to follow the method of W. S. Murray, electrical engineer of the New York, Newhaven and Hartford Railroad, who prepared a table showing the performance of a given number of steam and electric locomotives operated on the same system. The electric locomotive was no more complex than the New York subway cars, and as the latter had proved easy to care for despite their great number of movements, he did not apprehend any difficulty in maintaining electric locomotives in a service requiring far less movements, nor would the track repairs in electric service be greater than those due to the introduction of higher acceleration, quicker braking and increased speeds. In summing up, the speaker said that there were other factors to be considered besides the financial ones, such as multiple unit operation, cleanliness, desirability of a subway service on trunk lines through large cities, the independence of weather conditions, &c.

N. W. Storer, chief engineer of the railway department of the Westinghouse Electric and Manufacturing Co., said that his only fear was that the demand for electric locomotives would be greater than the facilities of the manufacturers to supply them. He said in humorous vein that as there were 47,000 steam locomotives to be replaced, or 4,700 locomotives a year on the basis of 10 years' life, he really did not want to see them replaced so rapidly. He wanted to bring out, however, the fact that in the steam locomotive the maximum speed was fixed by the boiler capacity and the economical rate of expansion in the cylinders, but in the electric locomotive with gearless motors a certain tractive effort could be had at any speeds up to 70 m.p.h., with economical voltage regulation. The Newhaven locomotive had an efficiency of 60 to 65 per cent. with a continuous tractive effort up to 10 m.p.h., and 87 to 88 per cent. at 50 m.p.h. with normal voltage. The latter speed could be exceeded 10 to 20 per cent. simply by increasing the applied voltage, and at the same time the efficiency increased as the speed increases. Hence the most economical speed was the highest that was safe to operate. Instead of 10 m.p.h. up a 2 per cent. grade, it was just as easy to make 20 or 25 miles, which, of course, meant a great increase in the capacity of the road.

The next speaker, J. E. Muhlfeld, superintendent of motive power of the Baltimore and Ohio Railroad, began his remarks with a reference to the paper presented by him on February 16th, 1906, before the club, on "Large Electric and Steam Locomotives," in which figures were given of the cost of operating the electric locomotives used by his company, and wherein certain suggestions were made for the improvement of electric locomotives in general. He said that while the electric locomotive might be a necessity in tunnel service it was an expensive proposition where the question was simply one of handling a given tonnage. He then presented a comparison of shop charges made for 1½ years to 2½ years previous on steam and electric locomotives used by the Baltimore and Ohio Railroad. These figures, which cover the running repairs and supervision per 100 miles, are given herewith:—

Three passenger electric locomotives, tractive effort 28,000 lb.; weight, 196,000 lb.; cost of mechanical and electrical repairs, $19.20.

Three freight electric locomotives, tractive effort 70,000 lb.; weight, 320,000 lb.; cost of mechanical and electrical repairs, $12.70.

Mallett articulated type steam locomotives, tractive effort 64,000 lb.; weight, 335,000 lb.; cost for repairs per 100 miles, $5.75.

Thirty-five passenger steam locomotives, Pacific type, tractive effort 35,000 lb.; weight, exclusive of tender, 230,000 lb.; cost for repairs, $4.35.

One hundred and seventy-five steam locomotives, consolidation type, tractive effort 42,000 lb.; weight, 209,000 lb.; cost for repairs, $3.15.

Compared on the basis of average cost per 1,000 lb. of rated power, the figures per 100 miles were as follows:—

Passenger electric locomotives, 68 c.; freight electric locomotive, 18 c.; Pacific type steam locomotive, 12½ c.; Mallett type freight locomotive, 8 c.; Consolidation type freight locomotives, 7½ c.

Compared on the basis of the same tractive effort, the average cost was $84 for the electric and $41 for the steam locomotive.

The figures given by Mr. Muhlfeld do not include interest, depreciation, or taxes in either case, nor are the electric locomotives debited with the cost of maintaining feeder, third-rail, bonding wires, switches and other equipment incident to electric service.

The original cost of the different locomotives made on the basis of total working weight is as follows:—Passenger electric, 20 c. per lb.; freight electric, 12 c.; Mallett, 9 c.; Pacific, 8 c.; and Consolidation, 8 c.

Mr. Muhlfeld said that the brilliantly lighted cars, hourly service and first-class signals mentioned by Mr. McClellan were regular features of his company's line between Baltimore and Philadelphia, and hence were not peculiar to electric operation. In regard to the multiple-unit operation of electric locomotives, he had found that when two locomotives were at the head of a train their combined tractive effort was only 90 per cent. of what it would be if one of the locomotives were at the end of the train. The points made about the time lost in round houses by steam locomotives did not apply to the Baltimore and Ohio Railroad, as it had passenger locomotives running anywhere from 8,000 to 12,000 miles per month, and freight locomotives giving 6,000 miles monthly. As to Mr. Storer's remarks about the 10-year life of steam locomotives, his experience was that the average life was 20 to 25 years.

C. A. Seeley, mechanical engineer of the Rock Island Pacific Railroad, Chicago, referred to the proposed electrification of the terminals of the steam railroads in Chicago. In Mr. Seeley's opinion, however, such electrification in Chicago would not at the present time be either profitable or desirable. When the New York Central electrification was finished and all the bills were paid, it would then be an appropriate time to determine the desirability of electricity for steam railroad terminal service. The installations at both Baltimore and New York were necessary on account of tunnels, heavy traffic and other local conditions. There was little direct evidence at present pointing to any direct economy of electric operation. In his opinion density of population was the deciding factor. He was a believer in electricity under favourable conditions; he also believed that improvements were possible in the present steam locomotive. The Rock Island Railroad was now trying experiments with superheaters on its locomotives.

The next speaker was L. B. Stillwell, consulting engineer, New York. Mr. Stillwell referred to the figures given in Mr. Tolte's paper relative to the possible saving of 1·65 lb. of coal per drawbar horse-power by using different auxiliaries. Such a large saving seemed rather strange to him in view of the fact that inventors had been trying for years to reduce the coal consumption per horse-power in large central stations. The latter were equipped with large

generating units using condensers, stokers, feed water heaters, superheaters, and other auxiliaries, some even pop-valves and carbon-dioxide recorders, yet they had not succeeded in securing a drawbar horse-power for 1·65 lb. of coal. If Mr. Toltz was right, it would seem that the proper thing to do would be to build 200 250-H.P. stations instead of one 50,000-H.P. station, and perhaps also to put these power stations on wheels to secure this high economy. The first Mallett locomotive tested in St. Louis had developed a drawbar horse-power per 2·6 lb. of coal, although equipped with automatic stokers, smoke preventers, and other fuel-saving devices. Referring to the exceptions taken by Mr. Toltz to the figures given in the paper by Mr. Putnam and himself on the amount and cost of fuel used by locomotives throughout the United States, Mr. Stillwell said their comparison was based not only on the reports of the Interstate Commerce Commission, but also on confidential information from many railroad officials. In fact, the results given covered the experiences of many of the greatest railroads, and included about 25 per cent. of the total mileage of the country and a locomotive mileage for the periods for which the data were given of 314,000,000 miles. The average price of coal per long ton was found to be $1.96, and the coal consumption per locomotive mile was over 174 lb. for freight and 101 lb. for passenger service. He wanted it understood that the objects of their paper were three: to promote the early standardisation of electric traction equipment; to create the proper perspective to impress electrical engineers with the magnitude of the change; and to secure an alternating current frequency having reference to the purchaser's interests rather than the manufacturer's convenience, whereby the maximum drawbar pull per dollar invested would be secured. While some of the savings given in their paper were assumed, most of them were drawn from practice. For instance, the figures on repairs and renewals of electric locomotives were based on the experience of six roads with a motor car-mileage of over 60,000,000 miles. The New York subway results were based on 400-H.P. equipments on each car of, say, an eight-car express train, the total of 3,200 H.P. being equal to double that of the most powerful steam passenger locomotive. Considering the figures obtained from this service, a number of inter-urban roads, and the Valtellina line in Italy, the maintenance costs mentioned by Mr. Muhlfeld were surprisingly high. In conclusion, Mr. Stillwell referred to several other items in the paper by Mr. Putnam and himself and explained how the costs were obtained.

The next speaker was A. H. Armstrong, of the General Electric Co., who said that Mr. Muhlfeld had taken a rather narrow view of the problem in comparing the cost of maintenance of the earliest type of electric locomotive with the latest type of steam locomotive. It would be very much as if some one were to compare the performance of the "De Witt Clinton" and an electric locomotive. In his mind the problem was not one of small economies, but of satisfying the demand for service that could not be filled by steam locomotives. The increase of the carrying capacity of a railroad over mountain grades was a case in point. The electric locomotive recognised no such thing as a ruling grade, and this made it available for severe grades where the traffic had been hitherto limited by the conditions inherent to steam railroad operation. A saving of 20 per cent. in the cost of fuel was a very small item compared to the benefits of doubling the capacity of the line.

## THE HELION LAMP.*

By W. G. CLARK and H. C. PARKER.

In the development of the Helion filament, we experimented with a great many substances covering practically every element whose physical properties gave any promise of success, and we became convinced that while some metallic substances would withstand the temperature necessary to produce an efficient filament, the low resistance of metals would necessitate that the filaments should be of exceedingly small cross-section in order to utilise the voltage of an ordinary circuit in a lamp of commercial size.

It is exceedingly difficult to produce a filament from the refractory metals, of the small cross-section necessitated, and if the filament is produced, it is exceedingly fragile.

Our early observations along this line have been borne out by the difficulty experienced in producing, commercially, a practicable metallic filament lamp for commercial voltages. In producing a lamp filament from material of lower conductivity or higher resistance, than a metal, it is possible to use a greater cross-section for a given degree of incandescence at a given flow of current. Some early experiments by Mr. Clark indicated silicon as a material which gave promise of considerable success.

We experimented upon this material for several years, and after repeated failures, we succeeded in producing the desired material in the form of a filament, possessing the necessary characteristics for use in an incandescent lamp.

The method by which the filament is made is very similar to the one used in treating or flashing the ordinary carbon filament, as we use a base of carbon very similar to the ordinary filament, on which we deposit a silicon compound out of gases which are introduced into a flask of the same general type as used in producing a carbon filament. As soon as the material begins to deposit upon the surface of the filament, the emissivity in the visible range immediately increases and with practically no change in the current consumption, the brilliancy increases very materially. The permanency or life of the filament at the temperature at which we operate, is apparently dependent upon the amount of the compound

Fig. 1.—Helion Lamp, 29 c.p., ·26 amp., 110 volts.

which is deposited upon the filament, but when a sufficient amount is deposited, we still retain a resistance high enough to absorb 110 volts in a single corrugated loop. (Fig. 1.)

We have been able to produce lamps of this character for 110 volts consuming 30 watts, giving 30 c.p., and withstanding a temperature of 1,750° (black body measurements), without any apparent disintegration or blackening of the globe.

Another characteristic of the filament is that, while the material applied to the filament in our treatment has a negative temperature coefficient of resistance and the carbon on which it is deposited has a negative temperature coefficient, the completed filament exhibits this negative coefficient only to about 1,400° C. (black body temperature), at which time it reverses and becomes positive. The positive temperature coefficient increases very rapidly as the temperature increases, so that in this respect, the filament has both the desirable feature of negative temperature coefficient from the central station point of view and a positive temperature coefficient at the temperature at which it is operated, which is valuable from the consumer's point of view, as it enables a lamp to better withstand increases of voltage than would be the case if the temperature cofficient were negative.

The curve shown in fig. 2 is plotted from candle-power determinations on the carbon filament and the Helion filament made by the Electrical Testing Laboratories. The temperature determinations were made on the same lamps by means of the Féry absorption pyrometer at Columbia University. It will be noted that the

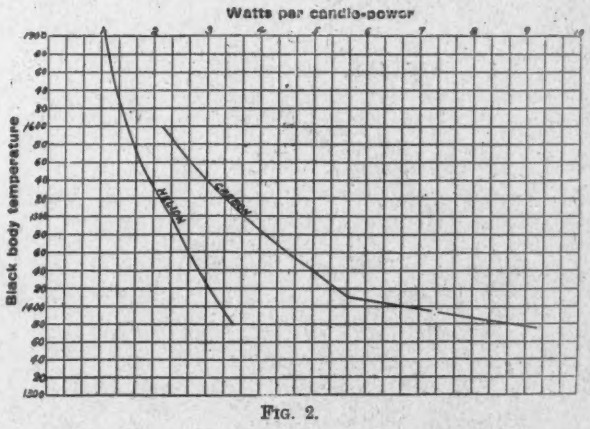


Fig. 2.

carbon filament lamp at 1,380° required practically 9 watts per candle, while the Helion filament at this temperature required but 3½ watts; at 1,500° the carbon filaments required 3¾ watts per candle, the Helion filaments, 2¼ watts per candle.

The carbon filament lamp was rated at 3½ watts per candle-power. At this rating the temperature observed on the pyrometer was 1,510°; at 1,600° the carbon filament lamp required 2¼ watts per candle, the Helion, 1½ watts per candle-power.

At this temperature, the disintegration of the carbon filament was so rapid that the efficiency began to fall off very materially before another reading could be made, but the Helion filament was carried up to 1,700°, at which temperature it consumed 1·07 watts per candle-power. In raising the temperature on these filaments from 1,400° to 1,600°, the resistance of the carbon filament decreased 4 ohms, while the resistance of the Helion filaments increased 5½ ohms. From 1,600° to 1,700° (black body temperature) the resistance of the Helion filament increased 9 ohms.

Conclusive life tests have not been completed upon the low candle-power filaments of small cross-section, but life tests made upon filaments of greater cross-section for higher candle-power at 1 watt per candle-power lasted up to, in one case, as high as

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* *School of Mines Quarterly*, July, 1907.—*Abstract.*

1,270 hours, and on a number of filaments upward of 700 hours, and in each case the drop in candle-power was very small, only about 3 per cent. In each case the lamp failed, at or near the joint where the filament was united to the platinum leading-in wires.

We find that the cement used for uniting the filament to the platinum, acts upon the filament, so we are at the present time engaged in the development of a cement for making this joint, which will not act upon the filament, as the lamps of low candle-power must necessarily have filaments of reduced cross-section, but the amount of cement used is practically as great as though the filament were of much greater cross-section. For this reason, a cement which acts upon the surface will destroy the small filament much more quickly than it does a filament of greater cross-section; but our experimental lamps have operated under laboratory conditions at an efficiency of 1 watt or less per candle-power for a period of time, which encourages us in the belief that the Helion filament can be made commercially practicable at an efficiency of 1 watt per candle, with the added advantage that the light given by the Helion lamp is a pure white, more nearly resembling sunlight than any artificial illuminant yet produced.

## A GRAPHICAL METHOD OF DETERMINING THE VOLTAGE DROP IN POWER DISTRIBUTION SYSTEMS.

By T. L. KOLKIN.

The determination of the voltage drop, size of conductors, and situation of sub-stations or feeding points for a large railway or power distribution system by means of an analytical calculation is, in most cases, a complicated process. A much more simple, and also more exact, method is the so-called graphical method.

To use this to advantage, a certain amount of practice is, of course, required, but owing to its relationship with graphic statics, this is easily gained. In the following lines I will deal with the cases most commonly met in practice.

Suppose A, B, in fig. 1, represent a conductor of a resistance of $r$ ohms per unit of length, say per km., and that in

Fig. 1.

distances $l_1$, $l_2$ and $l_3$, from A the currents $i_1$, $i_2$ and $i_3$ amperes are being tapped off.

We will further assume that the conductor is being fed at A only; the voltage drop $e$ in volts from A to B is then—

$$e = i_1 l_1 r + i_2 l_2 r + i_3 l_3 r = r \Sigma (i l),$$

where $i_1$ $i_2$ and $i_3$ = current in amperes,

$l_1$ $l_2$ and $l_3$ = lengths in units,

and $r$ = ohms per unit of length.

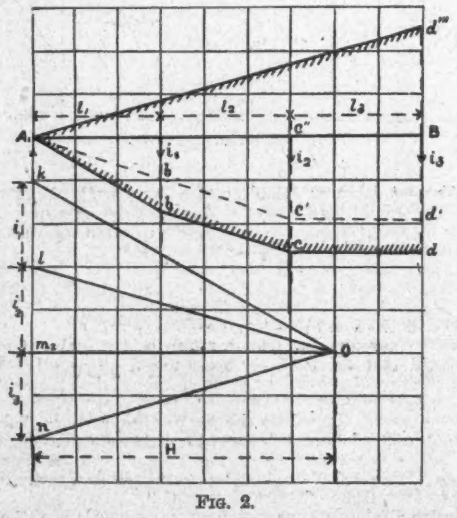


Fig. 2.

Graphically this drop can be determined by drawing up a diagram of forces (amperes), and a load diagram as shown in fig. 2.

In the figure the distance $b\,b'$, multiplied by a certain constant depending on the scale chosen, represents the voltage drop $e$ in the conductor in the length $l_1$. This can easily be proved. In order to simplify matters, we will select the pole distance, &c., in such a way that the distance $b\,b'$ gives the voltage drop directly in volts.

If $i_1$ $l_1$ and $r$ as before represent the current, length and resistance, we have the voltage drop—

$$e = i_1 l_1 r.$$

The triangle A $b\,b'$ being similar to the triangle O $k\,l$, we have further—

$$\frac{i_1}{\text{H}} = \frac{b\,b'}{l_1} = \frac{e}{l_1} = \frac{i_1 l_1 r}{l_1} = i_1 r,$$

and

$$b\,b' = \frac{i_1 l_1}{\text{H}} = i_1 l_1 r.$$

This means that if we make $\text{H} = \frac{1}{r}$, $b\,b'$ represents the voltage drop in volts.

The total drop A to B in fig. 2 is represented by the distance—

$$d\,d''' = b\,b' + c'\,c'' + \text{B}\,d''';$$

$$\frac{i_1}{\text{H}} \text{ being } = \frac{b\,b'}{l_1}, \quad \frac{i_2}{\text{H}} = \frac{c\,c'}{l_1 + l_2},$$

$$\text{and } \frac{i_3}{\text{H}} = \frac{\text{B}\,d'''}{l_1 + l_2 + l_3},$$

we have $$v_1 = \frac{i_1 l_1 + i_2 (l_1 + l_2) + i_3 (l_1 + l_2 + l_3)}{\text{H}},$$

and as $$\text{H} = \frac{1}{r},$$

$$v_1 = r \Sigma (i l).$$

We will now consider the case in which the conductor is fed at A and at B, and here assume that the voltage at A is the same as at B, and that $i_1$, $i_2$ and $i_3$ amperes is being tapped off at the points marked 1, 2 and 3 in fig. 3.

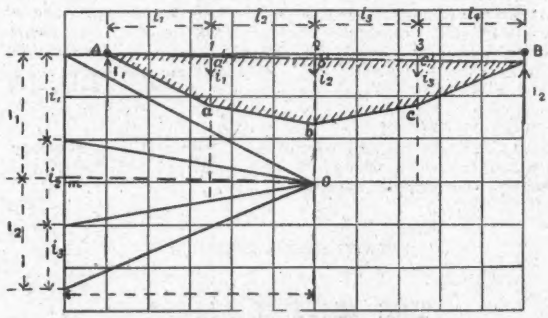


Fig. 3.

In the same way as before, it can be shown that the vertical distances $a\,a'$, $b\,b'$ and $c\,c'$ represent the voltage drop at the points 1, 2 and 3 in the figure referred to.

In fig. 3 we have assumed that the conductor (line) is being fed at A and B; it is evidently of great interest to

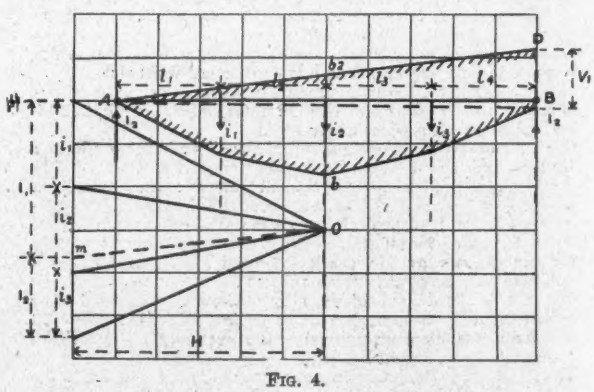


Fig. 4.

know how the feeding current is distributed between the two points A and B—(1) with the same voltage at A as at B; and (2) with different voltages at the two points.

The feeding currents $I_1$ at A and $I_2$ at B are determined in the same way as the support pressure at A and B in

graphic statics. In the case of the voltage at A and B being the same, we have only to draw a line O $m$ in the diagram of forces, fig. 3, parallel to the closing line A B in the load diagram, and $I_1$ and $I_2$ in the figure represents the feeding currents at A and B respectively.

We will now consider the case in which the voltage at A is different to that at B, and assume that it is $V_1$ lower at

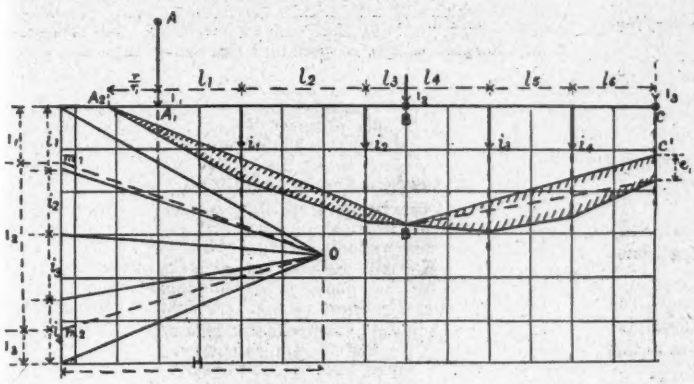


FIG. 5.

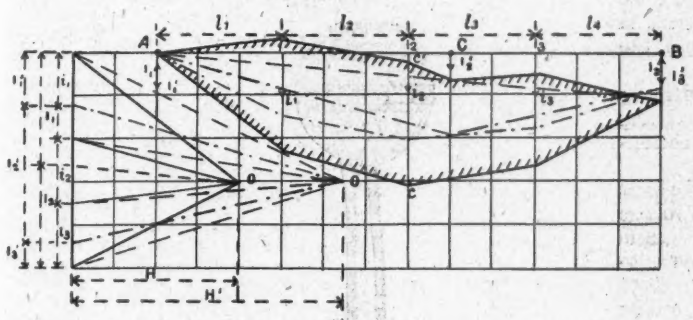


FIG. 6.

B than at A. This case is dealt with in fig. 4. $V_1$ is added to the voltage at B, as indicated in the figure by making B D = $V_1$. The voltage drop from A to a certain point on the conductor is then represented by the distance between the corresponding points on the polygon and on the closing line A D; for instance, at 2 the voltage drop is represented by the distance $b\ b_2$. The feeding currents $I_1$ and $I_2$ at A and B are determined in the same way as before by drawing the line O $m$ in the diagram of forces parallel to A D.

We will now consider the case in which we have a generating station or sub-station at A, fig. 5, at a distance $L_1$ from the line to be fed, a sub-station at B close to the line and a second sub-station, or feeding point, at C, the voltage at this point being $e_1$ volts lower than at A and B. The feeder $L_1$ is converted into an imaginary conductor of the same resistance $(r)$ per unit of length as the main conductor A B C, and drawn to the left of A, as shown in fig. 5. Assuming that the total resistance of $L_1 = r_1$ ohms, the length of a conductor equivalent to $L_1$ of $r$ ohms resistance per unit of length would be $\frac{r_1}{r}$. This is the length $A_1\ A_2$ in fig. 5.

The load diagram is drawn as shown in fig. 5. The feeding current $I_1$ at A is determined by drawing the line O $m_1$ parallel to $A_2$ B′ and the feeding currents $I_2$ and $I_3$ at B and C are determined by drawing the line O $m_2$ parallel to B′ C′.

We have in the foregoing considered the voltage drop in one conductor only. Fig. 6 indicates how the total drop in the positive and in the negative conductors of a direct-current distribution system is determined. The losses in the two conductors are determined separately and added together, as indicated in the figure.

We will assume that one of the conductors has a resistance of $r$ ohms per unit of length and the other conductor one of $r_1$ ohms, hence—

$$H = \frac{1}{r} \text{ and } H_1 = \frac{1}{r_1}.$$

We will further consider the former as being the positive conductor supplying the currents $i_1$, $i_2$ and $i_3$, and the latter as being the negative conductor with equal potentials and return cables at A, B and C.

The positive conductor is fed at A and B, and we will take the potential at A to be the same as at B.

After having determined separately the losses in the two conductors, we find the total drop by an addition of the former, as indicated in fig. 5.

For instance, the total drop in the two conductors from A or B to the point 2 in the figure referred to is represented by the distance $c\ c'$.

We will now consider a specific case—for instance, a tramway or light railway, say, 10 km. long. The generating station, we will assume, is situated about 2 km. from the terminus and 1 km. from the line. We will further assume that the distribution of the load along the line, as shown in fig. 7, is the most unfavourable one, that the track has a resistance of ·02 ohm,

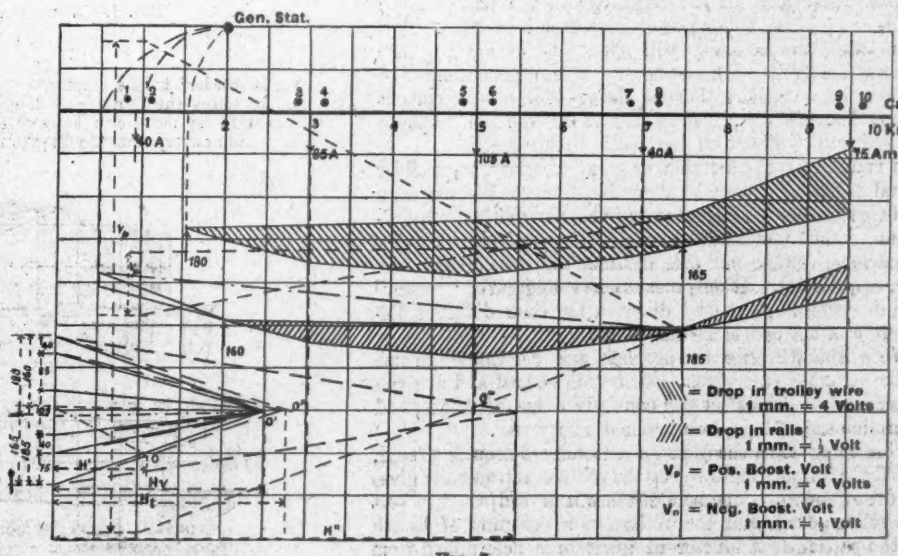



FIG. 7.

and the trolley wires (double) have a resistance of ·145 ohm per km. run.

The negative cable from the generating station to A has a resistance of ·035 ohm per km., and is thus equivalent to $\frac{0{\cdot}035}{0{\cdot}02} = 1{\cdot}75$ km. of track. The positive cable from the generating station to A has a resistance of 0·07 ohm per km., and is thus equivalent to $\frac{0{\cdot}07}{0{\cdot}145} = {\cdot}483$ km. of trolley wires.

After a rough investigation, we shall find (1) that a

negative booster is required, and (2) that also a positive booster will be needed in order to keep the cost of copper within reasonable figures.

The negative booster cable has a resistance of, say, 0·0467 ohm per km., and the positive booster cable a resistance of, say, ·07 ohm per km.

In fig. 7 we will use the following scales :—

$$1 \text{ km.} = 20 \text{ mm.}$$
$$10 \text{ amp.} = 1 \text{ mm.}$$

In order to make 1 mm. represent 1 volt in the fig. for the rail drop, the pole distance $H_r = \frac{1}{r_r}$ should have the following dimension measured in mm.—

$$\frac{1}{10} \cdot \frac{20}{H_r} = 1 \times 0{\cdot}02,$$
$$H_r = 100 \text{ mm.}$$

This would give a rather small scale for the rail drop, and we will, therefore, make $H_r = 50$ mm. This means that 1 mm. represents 2 volts in the rail-drop diagram.

In drawing up the load diagram for the rail circuit, we find that the point at which the negative booster-cable should join the rails is at about 7·5 km. This gives us at the particular load distribution a rail drop from 7·5 km. to 9·5 km. of 3 volts, and from 7·5 km. or 2 km. to 5 km. of about 3·6 volts. The return current in the booster cable we find amounts to about 185 amperes, and the current in the return cable joining the rails at 2 km. to about 160 amperes.

With regard to the trolley wire and positive feeders, we shall allow a voltage difference of 30 volts from the generating station to 7·5 km., and assume that the positive booster-cable joins the trolley wire at the latter point.

After having determined the pole distance $H_t$ in the same way as before, and thereby selected a scale for the voltage drop of 1 mm. = 4 volts, we draw up the load diagram in the ordinary way. The booster current we find amounts to about 165 amperes, and the feed current at 2 km. to about 180 amperes. It now remains to determine the booster voltages. These are represented by $v_n$ (negative) and $v_p$ (positive) in the diagram, and are found in the usual way by means of the load diagram and the diagram of forces, after the pole distance H′ for the negative and the pole distance H″ for the positive booster cable have been calculated.

In this connnection I will not omit mentioning the necessity of taking the regulation of the generators and boosters into consideration in fixing the return current lay-out in each case, but as this is outside the scope of this article, it will not be dealt with further here.

It is often found desirable, or even necessary, to consider several positions of the cars along the route, so as to ascertain whether the feeding arrangements will comply with all requirements. When the distances are drawn up and the scales for the current, voltage and pole distance are once settled, this is an easy matter. It only means a new diagram of "forces," with its corresponding load diagram for each different distribution of the cars along the route.

We will now reverse the problem, and determine the size of the feeders from a given distribution of load and a given voltage drop. We select any convenient size of feeder, and determine the voltage drop in the ordinary way.

This being done, the scale for the voltage drop is altered, so that the distance representing the voltage drop actually gives the drop allowed. The pole distance H is readjusted to suit this voltage drop, and the resistance $r$ per unit of length for the particular conductor in question is determined from the equation—

$$r = \frac{1}{H},$$

whereby the size of the conductor is given.

**Iron Cement.**—Messrs. Kirlew Bros., Ltd., of 215, Pentonville Road, N., have sent us a sample of their metallic filling for repairing defects in iron and steel castings, &c. When mixed with water to a thick paste, this cement sets hard in 24 hours, without heating. When set, oil, steam, and water have no effect on it; and it can be filed, hammered and polished.

## NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

### New Intercommunication Telephone.

The accompanying illustrations (figs. 1 and 2) show two forms of a new patent intercommunication telephone which has been introduced by the Bell Telephone and Electric Co., of Parliament Chambers, Great Smith Street, S.W. This has been devised to provide an instrument which will come within the reach of many who have previously been unable to afford such a convenience. The sets are of very compact design, a special feature being that the line

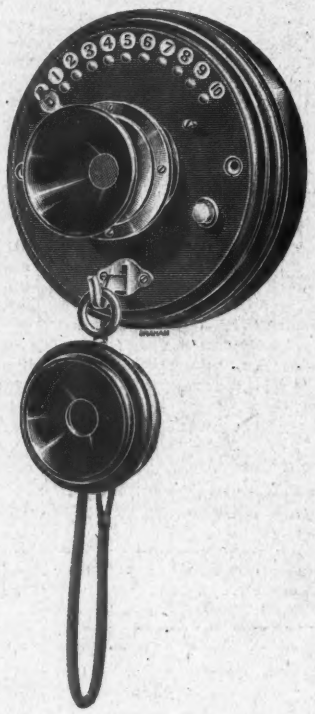


Fig. 1.—Wall Pattern.

selector is attached to the transmitter. The transmitter itself is rotated to select the line required, and this not only enables the instrument to be more compactly designed, but also agitates the carbon granules every time the telephone is used, thus keeping the

Fig. 2.—Table Pattern.

microphone always in a fully sensitive condition. Another new feature is that the step-by-step movement of the line selector is accomplished without the aid of special mechanism of any description, the contact studs themselves, with the aid of a slot in the spring arm, defining the position of the latter. These telephones have already found favour with architects for use in

private houses, where they can be fitted in any of the rooms without presenting an unsightly appearance. The external diameter of the wall set is 5⅜ in., and the base of the table set measures 4½ in. × 5 in.

### New Knife Switch.

Messrs. Morris & Lister, of Carlton Works, Lockhurst Lane, Coventry, have designed a cheap and effective small quick-break knife switch for currents up to 15 amps. and voltages up to 500. It is a registered design. It is claimed that in many cases it can

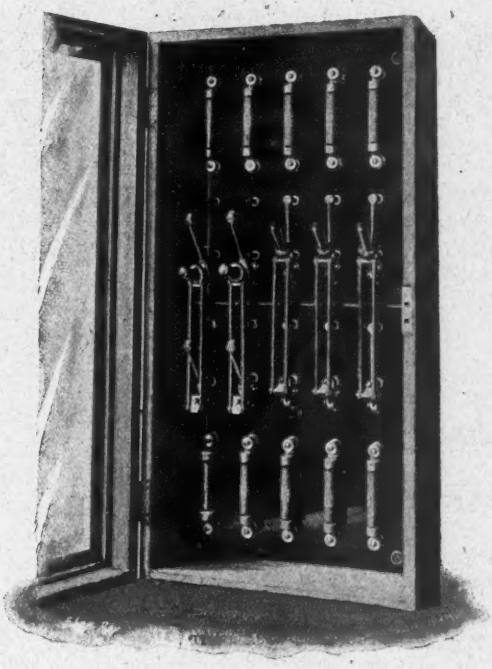


Fig. 3.

advantageously be used in place of the ordinary tumbler switch as, for instance, on distribution boards, for which it is particularly adapted, as shown in fig. 3. The main contact blade is of copper, being pivoted to, and carried by, a light aluminium die casting. The use of die castings in switch design is claimed to be a new feature, and it enables a considerable saving in cost to be effected. The copper blade is spring controlled so as to give quick break. The contact clips are of brass, and are either secured to front terminal blocks or project through the slate for back connections.

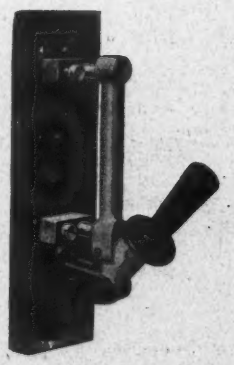


Fig. 4.—Quick-Break Knife Switch.

Fig. 5.—Knife Switch in Iron Case.

The makers also supply these switches fitted in a neat cast-iron case, making an effective house-service or motor switch. These boxes are made double-pole or triple-pole, and with inside or outside handles.

## BUSINESS NOTES.

**Sun Electrical Co. v. Zoga.**—This partly heard case came before Judge Woodfall in the Westminster County Court on Friday, when counsel for the plaintiffs said it was a claim for the price of an arc lamp. The lamp was to burn six hours, and the defence was that after four hours its illuminating power began to diminish. The case was adjourned for a test in the presence of an expert, and the test had shown that the lamp burnt for six hours. The expert was now present to give evidence to that effect. The defendants were not represented in Court, and judgment was given for the plaintiffs, with costs.

**Illuminations at Nuneaton.**—Nuneaton (Warwickshire) celebrated the granting of its Charter of Incorporation as a Municipal Borough recently, and the town was gaily decorated for the occasion. We are informed that the illuminations with electric glow lamps were on a large scale, and were very effective. The work was done by Messrs. Parsons, Sherwin & Co., Ltd., engineers, of Nuneaton. The temporary wiring consisted mainly of "Glowire" strip supplied on hire to Messrs. Parsons, Sherwin by the Gabriel Lamp Co., of London.

**Prompt British Traders.**—"The failure of the American manufacturer," says the American Consul-General at Antwerp, "to supply goods on time is a subject of frequent complaint, and of this the British manufacturer is taking advantage and rapidly supplanting his American competitors whenever prompt delivery is required. This refers particularly to machinery." On investigation the Consul found that orders for boat motors, pumps, parts of machinery, &c., given to American manufacturers have not been executed sometimes for periods varying from 4 to 18 months when customers had ordered by cable and desired immediate delivery. In a number of such cases British houses have been appealed to and the goods delivered and paid for by the consumer long before the American house thought of executing the original order.—*Practical Engineer.*

**Correction.**—In the article on "Trade Opportunities in South America," line 18, second column, page 566, the word *inferior* should have been *superior.*

**Gold Medal.**—The Electric and Ordnance Accessories Co., Ltd., of Birmingham, have just been awarded a Gold Medal by the New Zealand International Exhibition. In their exhibit a special feature was made of the Stellite telephones and telephone accessories, in addition to their general electrical manufactures. The exhibit was in the hands of the company's sole agents for New Zealand, Messrs. C. A. Hamlin & Co., Auckland.

**Australia.** — According to advices received by the Australian mail on Saturday, and telegraphed from Melbourne to Fremantle (the last port of call in the Commonwealth), a deputation representing manufacturers of electrical machinery waited on the Minister of Customs on September 3rd, in connection with the duties under the new Tariff on electrical apparatus, dynamos, &c. They proposed that all electrical machines should be gathered together into three groups under one general heading. In one group, dynamos up to 500 h.p., and other machines which can be, or soon will be, made in Australia, should be placed together, and on these an adequate protectionist duty should be put. In another group of big machines on which it is desirable to levy a revenue duty should be placed, and third, the remainder of electrical apparatus should be listed. At present electrical machines are scattered over the metals and machinery portion of the tariff. The Minister said the suggestion was an important one, and promised to give it full consideration.

In the House of Representatives on September 5th it was stated on behalf of the Government that efforts had been made to obtain telephone insulators in the Commonwealth, but so far without success. The Government had given instructions, however, that tenders should be called for 50,000 insulators to be made in Australia.

**Catalogues and Lists.**—Messrs. C. A. Parsons and Co., Heaton Works, Newcastle-on-Tyne.—General catalogue (40 pp.), in which they give half-tone illustrations and particulars of tests of recent turbo-generator plants installed by them. Full descriptive notes of the Parsons turbine and its constructive details are given on alternate pages, the facing pages being occupied with the views which include one 2,000-kw. and four 500-kw. d.c. sets at Marylebone, three of 1,000 kw. at the G.E.R. power station at Stratford, and others at the Kent Electric Power Co.'s station and Carville power station, the results of the tests made last February on the 3,500-kw. set at the last-named station being shown in curve and tabular form.

Messrs. Crompton & Co., Ltd., London, E.C.—"The Crompton Pocket Catalogue" is a handy-sized book in neat red covers, in which appears an abbreviated price list of electrical machinery manufactured by the firm. In the course of its 100 pages we find brief descriptive and tabulated matter as well as a variety of well-executed small illustrations—half-tone and diagrammatic—relating to dynamos, motors, pumps, arc lamps, projectors, instruments, ceiling fans, switchgear and carbons. Some pages of definitions, formulæ, &c., are also included.

Messrs. Alfred Herbert, Ltd., Coventry.—New edition (the fourth) of Section H of their catalogue, in which the "Coventry" patent self-opening die-head is very fully described and illus-

trated. Attention may be specially directed to the patent "straight-cut" dies, and to the particulars given concerning their adjustability.

Messrs. Julius Sax & Co., Ltd., 100, Charing Cross Road, London, W.C.—12-page illustrated pamphlet describing their volt-meters and ammeters for D.C. and A.C. circuits.

The Union Electric Co., Ltd., Southwark, S.E.—16-page publication relating to their Hartmann-Kempf's standard frequency meters, based on the resonance principle, for wave curve periodic currents, for switchboard and portable service, also station synchronising frequency meters, frequency alarms, frequency meters for demonstration work, &c.

The British Prometheus Co., Ltd., 109, Oxford Street, London, W., and Birmingham.—New catalogue (44 pages art paper) in which appear many illustrations of pleasing and artistic designs of electric heating apparatus—both convectors and radiators. A new form of lamp—the Leitner-Prometheus glow lamp—is described. The list is well set out with tabular details of prices, code-words, &c., beneath the illustrations.

Messrs. Siemens Bros. & Co., Ltd., Westminster, S.W.—Two new pamphlets; one (No. RS. 4) describing fully, with many line diagrams, the system of electrically-operated railway points and signals designed by Mr. Ferreira, the engineer and manager of the firm's railway signalling department. The drawings represent the apparatus that is being manufactured to the order of the G.W. Railway for the entire equipment of their new Snow Hill station now in course of erection at Birmingham. The other (No. RS. 3) describes the Siemens mercury contact treadle for railway signalling, and gives full instructions for its installation. The mercury treadle has been adopted by both the G.W. and the Midland Railways.

Messrs. Elliott Bros., Lewisham, S.E.—New pamphlet (T.S. 96A) describing their double standard pattern of the Harrison universal photometer, and giving instructions for its use.

**Book Notices.**—*The Week-End and Holiday A.B.C.*—We have received the October monthly issue of this handy week-enders' and holiday-makers' guide.

"Proceedings of the Physical Society of London." Vol. 20, part 5. September, 1907. London: Taylor & Francis.

"Journal of the Franklin Institute." Vol. 164, No. 3. September, 1907. Philadelphia: The Institute.

"Proceedings of the American Society of Mechanical Engineers." Vol. 29, No. 1. September, 1907. New York: The Society.

"Electrical Traction." Vol. I, Direct-Current; Vol. II, Alternating-Current. By E. Wilson and F. Lydall. London: E. Arnold. 1907. Price 15s. each vol.

**Dundee Electrical Contracts.**—Our local correspondent writes that the Electricity Committee of Dundee are still suspicious that there is a combine among the big contractors. The suspicion has arisen in connection with the tenders for cables for the new station. It will be remembered that on the last occasion the contracts were under consideration the Committee decided to call for fresh offers in view of the similarity in price that existed between the tenders. Having regard to the fact that the copper market was falling, the Committee decided to ask for new tenders in the hope that they would benefit by the fall in the price of the metal. Since then copper has marked a considerable decline, but in the new offers submitted to the Committee last week, there was only a difference of about £19, and this on a contract amounting to nearly £12,000. The present price of copper being normal, and in view of a still further decline and the fact that there is no particular hurry in placing the contract for the cables, the Committee decided to instruct the engineer (Mr. Richardson) to call for tenders on two alternatives, (1) that the offer to supply cables should include excavation, and (2) that the tender should be for cables only, the excavation and filling in to be done by a local contractor or by the department's own workmen.

**Installation Contracts.**—Mr. C. Pullan, of Bradford, has obtained the contracts for a lighting installation from private plant, consisting of nearly 600 lights and a few arc lamps, for Messrs. J. Brownhill & Sons, Ltd., Denby Dale; also a complete lighting installation for wood-working shops, timber yards and offices, including generator and switchboard, for Messrs. J. Charnock & Sons, Ltd., Halifax, as well as an installation of photographic arc lamps, multiple Nernst lamps and incandescent lighting, for Mr. Denis R. Thompson, artist and photographer, Bradford.

**Trade Announcements.**—The business hitherto carried on under the style of Wm. Kenyon & Sons, at Chapel Field Works, Dukinfield, near Manchester, has been, for family reasons, converted into a private limited company. There will be no change in the management, and no shares will be offered to the public.

How, Partington & Co.—We understand that Mr. H. D. B. How and Mr. W. Partington, who were until recently district manager and engineer respectively, for Messrs. Bruce Peebles, Ltd., in South Wales, have entered into partnership, and taken the Alpha Works, at Taffs Well. The new firm will deal with repairs and breakdowns of electrical and mechanical apparatus in the district, and will undertake construction and erection work, cable-laying and jointing, &c.

Messrs. Thermit, Ltd., have been appointed sole agents in the United Kingdom for the sale of McKnight's tramway point silencers and heel adjusters, &c. Samples can be inspected at their offices at 27, Martin's Lane, Cannon Street, E.C.

Messrs. James Lawson & Co., Cardiff, announce that owing to increased business as electrical manufacturers' agents, they have removed to larger premises at 4, Church Street, Cardiff. Mr. James Lawson has also entered into partnership with Mr. H. T. Gould (late of the Power-Gas Corporation, Ltd.), as mechanical engineers, at the same address, and will represent the Power-Gas Corporation, Ltd., Messrs. Ashmore, Benson, Pease & Co., Ltd., and the Weldless Chains, Ltd. The electrical department will be carried on under the management of Mr. Harry Nance, as hitherto.

The Wednesbury Electrical Case Co. is the name of a new business started at Brunswick Park Road, Wednesbury, to undertake the manufacture of switch-cases, switchboard frames, fuse cases, teak blocks, and, indeed, all kinds of wood-work.

The Adams Manufacturing Co., Ltd., advise us that owing to increased demand for their "Igranic" motor starting and controlling apparatus in the Yorkshire district, they have just appointed as their agent in that district, Mr. Charles H. Holgate, of School Close Works, Leeds. Mr. Holgate will carry a large stock of the standard "Igranic" apparatus.

Mr. Geo. Henry Calverley, late of the firm of Calverley, Batty & Co., electrical engineers, Burnley and Nelson, has commenced business as an electrical engineer at 102, Manchester Road, Burnley.

The Crown Brass and Engineering Co., electrical engineers, River Street, Bolton, announce that they are giving up business.

**Dissolutions and Liquidations.**—Lawson and Stobbart, electric light and power engineers, 24, High Row, Darlington.—Messrs. J. Lawson & F. Stobbart have dissolved partnership. Mr. Lawson will attend to debts and continue the business.

The English Electric Carbon Co., Ltd.—Creditors must send particulars of their debts, &c., to the liquidator (J. S. Wynne, 6, Coedyfelin Road, Brymbo, near Wrexham) by October 19th.

The Capilliform Telegraph Instrument Co., Ltd.—Creditors must send particulars of their debts, &c., to the liquidator (H. Clough, 54, Gresham Street, E.C.) by November 10th.

The Conduit and Insulation Co., Ltd.—This company resolved on September 30th to wind up voluntarily, with Mr. C. J. March, 3, Church Court, Old Jewry, as liquidator, to whom creditors should send the usual particulars by November 5th.

The Electrical Ore Finding Co., Ltd.—Creditors must send particulars of their debts, &c., to the liquidator, Mr. J. D. A. Norris, Suffolk House, Laurence Pountney Hill, E.C., by November 19th.

The Rossendale Belting Co., Ltd., Manchester.—A winding-up order was made at Manchester on October 2nd.

**Theft of Cable.**—On the 7th inst., at Marylebone Police Court, Albert Brooker and Charles Messer were each sentenced to 28 days' hard labour for stealing cable from the Marylebone electricity department, where they were employed.

**Factories in North London.**—The Holloway Electric Supply Co. are building some workshops at their electric light station, Bovay Street, Holloway Road, which they are prepared to let to manufacturing electricians, accumulator makers, &c. Some particulars will be found among our advertisements to-day.

**Bankruptcy Proceedings.**—Robson, Robson & Co., electrical engineers, Newcastle-on-Tyne.—G. & J. S. Robson.—First and final dividend 2s. 4¼d.—G. Robson (separate estate), first and final dividend of 7s. 9d. in the £. Both payable at 1, St. Peter's Churchwalk, Nottingham.

**A Brussels Contract.**—With reference to our note of last week concerning the contract for the electric light installation at the Alhambra Theatre, Brussels, Mr. Maurice Closset, of Boul. du Hainaut, 93, Brussels, writes informing us that his firm has been entrusted with the whole of the work. Just at present he is busy with the construction of all the switchboards, and has many wiremen at the theatre running in the feeders for wiring the stage, making six battens, wiring the footlights, and decorating the front of the house with about 1,500 incandescent lights and 6 flame arcs of 25 amperes each.

**Teddington Trades Exhibition.**—A successful Exhibition was held at Teddington last week in conjunction with the tradesmen of the district. Messrs. R. Langston-Jones & Co., electrical engineers and contractors, had a stall on which they made a display of fittings, shades, standards, novelties, radiators, &c. A speciality was made of B.T.-H. heating and cooking devices, including water heaters, hot-plates, coffee or tea percolators and domestic and laundry irons, and their 6 lb. domestic flat-iron caught on well. Messrs. Poupart's electric laundry, of Twickenham, also had a stall on which were shown flat-irons and goffering irons in use, which created considerable interest. The local gas company also had a large stall, and lit the Exhibition with three large high-pressure gas lamps, and once again it was noted how gas engineers are imitating electric lighting engineers in the matter of switches, standards, &c. Messrs. Langston-Jones had a pair of 10-ampere Ediswan-Carbone flame arcs on their stall. Osram lamps were repeatedly inquired for.

## LIGHTING and POWER NOTES.

**Aberdeen.**—Under the terms authorised by Parliament for the purchase of the Cults electric lighting station by the T.C., a clause was inserted in the Bill whereby power was reserved to the Aberdeen County Council to acquire the undertaking by arbitration. Sir Alexander Kennedy recently visited Aberdeen, and made an inspection of the property, and his report was submitted to the County Council. The price fixed to be paid by the T.C. on acquiring the property was £9,000. At a meeting of the Special Committee of the County Council, held on Friday last, it was agreed on Sir Alex. Kennedy's recommendation not to purchase.

**Abertillery.**—A L.G.B. inquiry was held on October 1st relative to the application of the U.D.C. for a loan of £10,000 for lighting the South Ward of the district by electricity. It was explained that the Council had taken the step because there was every probability that a private company would have stepped in. Private consumers would be charged 5½d. per unit, and it was estimated that a profit of £132 would be made during the first year. The Ratepayers' and other Associations opposed.

**Arbroath.**—The Electric Lighting Committee has had an interview with Mr. Balfour in regard to the electric lighting scheme which his firm is to inaugurate. It was indicated that the work would be commenced early next year and finished by November.

**Burnley.**—The B. of G. is considering the advisability of having the Workhouse lit by electricity, and the borough electrical engineer is to report to the board as to the cost, &c., of the installation.

**Clonakilty, Co. Cork.**—A meeting was held last week to consider the advisability of settling on some definite scheme for the lighting of the town. Mr. J. C. O'Sullivan, J.P., presided. Several schemes have been under consideration; the representatives of the Alliance Electrical Co. and of an oil gas company submitted their respective schemes for the lighting of the town. After an exhaustive discussion the final decision was postponed till the end of this week.

**Continental Notes.**—ITALY.—La Societa Idro-Elettrica Italiana, of Milan, has applied to the authorities of the Province of Sondrio for a concession to put down a plant to utilise the water-power of the River Ligonico and several other streams in the district for the generation of electrical energy for lighting and power purposes.

**Crook.**—A request has been made by the County of Durham Electrical Power Distribution Co. for permission to install an overhead distribution instead of underground system, the company allowing a reduction in price of from 7d. to 3¾d. per unit. The Council has decided not to comply with the company's request on the grounds of the *unsightliness* of a pole line.

**Dover.**—The T.C. has decided to apply to the L.G.B. for a further loan of £1,000 for free wiring.

**Dundee.**—It has been agreed to light Overgate, one of the busiest thoroughfares in the city, with electricity. Owing to the rivalry between the Electricity and Gas Departments, a proposal is to be considered for the appointment of a Lighting Committee to embrace both departments.

**Hull.**—The T.C. has applied for a loan of £31,200 for electricity purposes.

**London.**—STEPNEY.—The Electric Light Committee in a report circulated on Monday stated that in connection with a resolution passed in July last by the Council authorising the development of the Blyth's Wharf extension scheme, the borough engineer and the borough electrical engineer and manager (Mr. W. C. P. Tapper) had submitted and explained the general outline plans prepared by them. Subject to the usual approval, the Committee had decided to invite tenders for (1) the complete equipment of the steam raising portion of the station plant, including condensing water pipes, river wells, and coal-handling plant; and (2) the complete equipment of the electrical generating portion of the station plant, including turbo-generator, high and low tension switchgear, and converting machinery. The contract will also include the removal of a portion of the plant already erected at Osborn Street and its re-erection at Blyth's Wharf. The total cost of the scheme, as already reported, will be approximately £57,000, and it is recommended that application be made to the London County Council for sanction to borrow that amount. The borough electrical engineer and manager having brought under notice the fact that as it is proposed to adopt a 6,000-volt transmission from Blyth's Wharf, and that this is a different voltage to that which exists at the Whitechapel station, it will be necessary to obtain the consent of the B. of T. to its adoption.

SUPPLY OF ELECTRICITY BILL.—The Associated Municipal Electrical Engineers of Greater London are asking the Borough Councils and other authorities to support them in urging the re-introduction next Session of the Supply of Electricity Bill, 1907, which was withdrawn owing to pressure of business, after passing the House of Lords and coming before the Commons. The measure has for several years been before Parliament, and a number of London local authorities have supported it

**Lynton.**—The U.D.C. has entered into an agreement with the local electric light company for a supply of energy for public lighting for 14 years.

**Monmouth.**—On October 3rd a L.G.B. inquiry was held into the application of the T.C. for a loan of £10,000 to repay money borrowed from the bank, without the sanction of the L.G.B., for E.L. purposes. The Inspector adjourned the inquiry until November 5th.

**Northallerton.**—The E.L. Co. has, in response to inquiry, informed the U.D.C. that it is not at present prepared to negotiate for the sale of the E.L. undertaking.

**Northfleet.**—With reference to the abandonment of the E.L. scheme by the Gravesend T.C., the U.D.C. has been advised by counsel that it is entitled to specific performance of the contract, especially for public lighting, and Gravesend T.C. has been informed that unless before October 15th the clerk receives an intimation that the T.C. will forthwith commence the necessary work a writ for specific performance will at once be issued, without prejudice to the question of damages.

**St. Helens.**—The Corporation has approved a recommendation of the Electricity Committee to provide the necessary plant and feeders, and to give a supply of energy to the St. Helens Collieries and the Ravenhead Collieries Co., at 3,000 volts (three-phase), subject to the St. Helens Collieries Co. guaranteeing the payment for a term of 10 years of £600 per annum, and of the charges for energy.

**Southampton.**—In our last issue we noted that the T.C. of Southampton is applying for powers to undertake free and assisted wiring, &c., it appears that the Corporation does not intend to carry out any installation work itself, and will leave this in the hands of the wiring contractors, but the Corporation proposes to find the money to carry on the work of the late Free Wiring Co., as this seems to be beyond the powers of an ordinary wiring contractor.

**Sowerby Bridge.**—The U.D.C. has decided to transfer the E.L. order to the Electrical Distribution of Yorkshire, Ltd., on a 21 years' basis, subject to the consent of the B. of T.

**Stockport.**—The T.C. has adopted a flat rate of 3½d. per unit, less 5 per cent. discount, for energy supplied to ordinary lighting consumers.

**Wednesbury.**—The T.C. has applied to the L.G.B. for a loan of £2,819 for cables and services.

**Wimbledon.**—The T.C. has applied to the L.G.B. for a loan of £3,600 for the provision of a new main switchboard.

**Woodbridge.**—The U.D.C. has referred to a Special Committee the question of E.L. The Suffolk Electricity Supply Co., Ltd., Stowmarket, has offered to light the town with 121 lamps for £350 per annum, and another E.L. scheme is to be presented to the Council by Mr. P. F. M. Richards in conjunction with Mr. Arnold Hansard, of Westminster.

**Worcester.**—During the last few weeks the last of the steam generating plant has been removed from the Powick (hydro-electric) station and installed at the Hylton Road works, thus obviating the duplication of staff necessary with two steam-driven stations. During the present year the water-power plant has generated some 430,000 units, and it is expected that the year's total will constitute a record.

## TRAMWAY and RAILWAY NOTES.

**Accrington.**—A service of electric cars from Accrington to Clayton-le-Moors, was inaugurated on Saturday last. The Mayor of Accrington (Alderman Higham) drove the first car. The Accrington ratepayers are anticipating an income of £3,000 a year in relief of local burdens.

**Bacup.**—The Town Council has offered a sum of £5,200 to the Rossendale Valley Steam Tramways Co., Ltd., for that portion of their undertaking which is within the borough. It rests with the Rawtenstall Corporation to say whether it will exercise it powers within the area; if not, the Bacup Corporation will seek Parliamentary powers.

**Birmingham.**—The inquest on the two men killed in the recent tramway accident, resulted in a verdict of "Accidental Death," with a rider that there was an error in judgment by the motorman in not returning the car immediately he found the magnetic brake was defective, and by the inspector in depending upon a brake which he knew to be defective. Mr. C. W. Hill, chief assistant and electrical engineer to the Tramway Committee, who gave evidence, stated that on examining the car after the accident, he found the cables in order. In frame No. 4 of one of the rheostats he discovered one of the grids fractured. The effect would be to destroy partially the continuity of the electrical circuit for the magnetic brake. In his opinion this fracture was entirely responsible for the unsatisfactory condition of the magnetic brake. A defect of that kind would not show itself until it affected the actual working of the car.

**Belfast.**—At the meeting of the Tramway and Electrical Committee on the 7th inst., the tramways manager submitted his report on the proposed extension of the tramway through the village of Ligoneil. From this it appeared that the work would cost about £9,500, including the equipping of the extension, whilst the expenditure in working would cost about £1,750 per annum. He was of the opinion that the extension could not be worked safely if the original plans were not modified. The revenue derived would be small. He considered that the extension in any case should not be carried out for some time.

**Black Country.**—Considerable irritation and indignation has been expressed at the action of the tramway company in having discontinued half fares for children travelling on its lines. No doubt the company is acting within its legal rights, having given the requisite notice of the change; but notwithstanding this it is considered unreasonable to ask children under twelve to pay full fares, and strong representations against this action are to be made to the company by the West Bromwich T.C.

**Bolton.**—The Corporation is about to extend its tramways from Bradford Street, Bolton, to Lever Bridge, Darcy Lever, an outside village included in the borough boundary.

**Continental Notes.**—Spain.—According to the Continental Press, the electrical operation of a standard gauge line is contemplated. A section some 22 km. long, between Santa-Fé and Gergal is to be taken in hand, and a special steam-driven power station erected at Santa-Fé, as a preliminary to using the water-power of the district for extended operations. The line equipment will be on the trolley system, which will operate at 5,500 volts. Five locomotives of 320 H.P. each will be utilised to haul trains of 150 to 300 tons each, at speeds of 25 km. per hour. The line is single track, and has a considerable freight traffic.

**L.B. & S.C. Electrification.**—Once more the electrification of the Victoria-London Bridge section of the Brighton Co., is troubling the daily Press. We now understand that the work will be completed in March next, and that eight three-coach trains are being provided for this section, which, at the present time, deals with 16 million passengers per annum.

**London.**—Camberwell.—After considerable discussion the B.C. has decided against a tramway from London Road, Forest Hill, to Sydenham Hill, and along the Crystal Palace Parade to the Palace main entrance. The alternative route, from the existing tramway at Herne Hill, *vid* Croxted Road, Gipsy Hill, and Westow Hill, to the Palace, was agreed to by a large majority.

L.C.C.—After discussion at Tuesday's meeting, the Council resolved to apply to Parliament in the next session for powers to construct short lengths of tramways at an estimated cost of £302,000. The proposed tramways are: (1) a double line between Gray's Inn Road and Caledonian Road, over the Metropolitan Railway Station; (2) a single line from King's Cross Road to Gray's Inn Road *vid* Swinton Street; (3) from Essex Road to Kingsland Road, Kingsland High Street to Mare Street and Kingsland Road and Dalston Lane; (4) Mitcham Road and Tooting High Street; (5) Blackfriars Road to Southwark Bridge Road *vid* Southwark Street; and (6) from West Norwood to the Crystal Palace. It was also decided to seek power to reconstruct the existing tramways in Lea Bridge Road and to extend them to Upper Clapton Road.

**Manchester.**—The question of the inter-running of cars between the city and Salford has been under the consideration of a joint committee for some weeks, but the result does not seem very satisfactory. An arrangement by which cars might be run, say, from Peel Green (Eccles) through Manchester to Brooks's Bar, or Fallowfield, had been hoped for. This, however, was found to be impracticable. Then it was intimated that a through running of Swinton and Salford cars to Belle Vue might be arranged. This also has now been dropped, and it is announced that further negotiations have been suspended.

**Northwich.**—It was announced at a meeting of the U.D.C. on October 3rd, that as no application for an extension of time for carrying out the Warrington and Northwich Light Railway Order had been made, the order, so far as Northwich was concerned, had lapsed.

**South America.**—A proposal has recently been on foot for the construction of an electric railway from La Plata to Buenos Ayres. Messrs. Otto Franke & Co., who proposed its construction in connection with a paved roadway alongside, are reported as opposed to go further with the matter should the Provincial Legislature decide to make two distinct contracts—one for the railway and the other for the roadway. It seems probable, however, that the Legislature will approve of Messrs. Franke & Co.'s railway offer, and put the construction of the road up to public tender.

**Stockport.**—The T.C. has applied to the L.G.B. for a loan of £15,473 for tramway purposes.

**Torquay.**—A suggestion has been made to the Council by Mr. J. A. Purvis, of Exeter, that he and his brother—owners of the Electric Light Provisional Order for Paignton—should supply electric power in bulk to the Torquay Corporation for the tramways. Messrs. Purvis are about to erect a station for generating electricity for the proposed extension of the tramway system from Torquay to Paignton. The Council did not regard the proposal with favour, but referred it to the Electric Lighting Committee for consideration. The Mayor remarked that they had their own electricity works and should not sacrifice them in order to take power in bulk from outsiders.

# TELEGRAPH and TELEPHONE NOTES.

**American Pacific Cable Interrupted.**—The officers of the Commercial Cable Co. report a break in their Pacific cable somewhere between the relay stations at Midway Island and Guam. They think that an earthquake may have been responsible for the interruption in the cable service, but in the absence of all word from the operators at Guam they cannot assign a cause positively. The *Electrical World*, in referring to the matter, says that the cable that goes under the Pacific from San Francisco to Yokohama and the Philippines *vid* Honolulu, Midway and Guam went dead on Friday, September 20th. "Midway, which lies between Honolulu and Guam, reported that the spark went out of the submarine wires without warning, and that all efforts to communicate with Guam had been unavailing so far this week. Since the Commercial Cable Co. line is the only one connecting America with the Orient directly, all cablegrams for the Philippines, Japan and points on the China coast will have to be sent around the other way at a rate about double that charged across the direct San Francisco-Yokohama line."

**Telegraphic Interruptions and Repairs:—**

| Cables. | | Interrupted. | Repaired. |
|---|---|---|---|
| Curacao-Coro<br>Curacao-La Guayra<br>Curacao-Maracaibo | Closed.. .. .. | .. Jan. 12, 1906 .. | .. |
| Tarifa-Tangier .. .. .. .. | | .. Jan. 18, 1904 .. | .. |
| Port Arthur-Chifu (Closed) .. .. .. | | .. Mar. 9, 1904 .. | .. |
| Garachico-Santa Cruz .. .. .. .. | | .. July 12, 1906 .. | .. |
| Las Palmas-Arecife .. .. .. .. | | .. Aug. 18, 1906 .. | .. |
| Brest-Dakar .. .. .. .. | | .. July 22, 1907 .. | .. |
| Midway Island-Guam .. .. .. .. | | .. Sept. 22, 1907 .. | |
| Martinique-Paramaribo .. .. .. | | .. Sept. 25, 1907 .. | Oct. 6 |
| **Landlines.** | | | |
| Puerto-Barrios .. .. .. .. .. | | .. Aug. 2, 1903 .. | .. |

**Wireless Telegraphy in China.**—The *Electrical World* quotes from a report by U.S. Consul W. T. Gracey regarding the German Government's new wireless telegraph station at Tsingtau, China, as follows:—"The local wireless station is on top of the Diederichs Hill, 328 ft. high, next to the signal station. For ships coming from the direction of Tschalien-tau light this hill appears as the farthest hill toward the south, and stands clear of the Bismarck, Iltis, and Prince Henry mountains, lying farther north. The system in use is 'Telefunken,' of Slaby-Arco, with a mast, the distance of activity being about 100 nautical miles. The station is the property of the Kiaochow Government, and is used to communicate with men-of-war of the German navy, but will be thrown open for general public use before long on conditions which have not as yet been determined."

**Power in Manufactures.**—The American Bureau of the Census has just issued a report on the power employed in manufactures. This report, which forms part of the census of manufactures of 1905, contains the statistics for the calendar year 1904, and was prepared by Mr. T. Commerford Martin, expert special agent. The total power employed in manufactures was 14,641,544 H.P. To this amount steam engines contributed 10,828,111 H.P., or 73·9 per cent.; water wheels, 1,647,969 H.P., or 11·3 per cent.; electric power, owned or rented, 1,592,483 H.P., or 10·9 per cent.; gas or gasoline engines, 289,514 H.P., or 2 per cent.; and other kinds of power, 283,467 H.P., or 1·9 per cent.

The New York *Electrical World* says that when compared with the figures reported at the census of 1900, those of 1905 show that in five years the total horse-power increased more than 40 per cent. The largest relative increase for any of the kinds of power was one of 270·5 per cent. reported for owned electric motors. Rented electric power increased 141·9 per cent., and the power of gas and gasoline engines, 114·9 per cent. The largest absolute increase, however, was reported for steam engines, the horse-power of which increased 2,687,578, or 33 per cent. The power of water wheels increased only 13·3 per cent. From these figures it is evident that although steam engines are by far the most important source of power, electric power and the power of gas and gasoline engines are becoming of increased relative importance in manufacturing. Water-power, while increasing absolutely, is diminishing in comparison with other kinds of power.

Power derived from electricity (1,592,483 H.P.) represents an increase over the amount reported at the census of 1900 of 1,099,260 H.P., or 222·9 per cent. The development was extraordinary in the States distinguished chiefly for heavy manufacturing on a large scale. The horse-power reported rose in Pennsylvania from 107,746 to 346,797, or 221·9 per cent.; in New York from 77,598 to 222,111, or 186·2 per cent.; in Illinois from 49,235 to 165,265, or 235·7 per cent.; in Ohio from 42,157 to 144,467, or 242·7 per cent.; and in Massachusetts from 32,828 to 91,017, or 177·2 per cent.

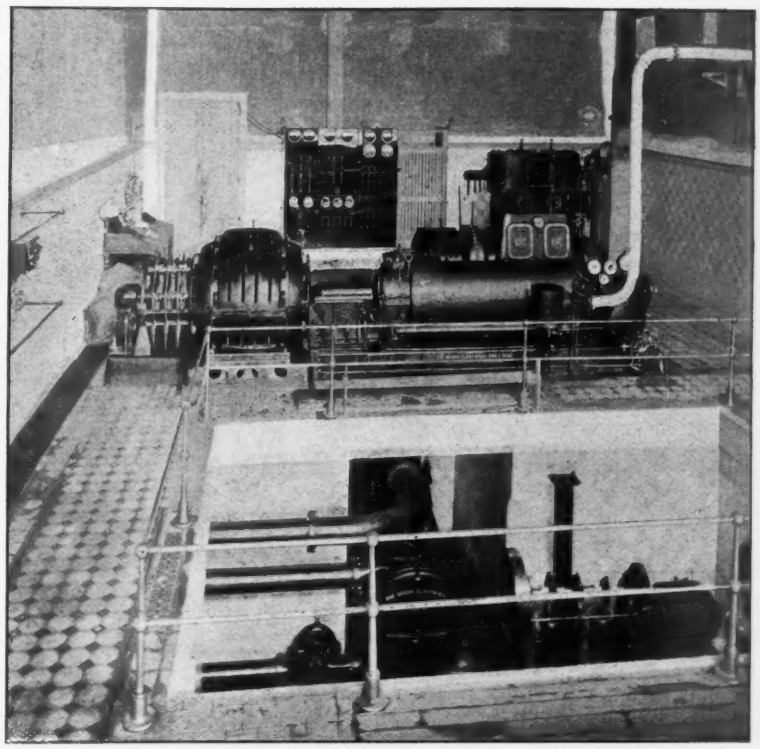
The increase in the number, size and total capacity of gas and gasoline engines has been another marked feature of industrial development. The number of gas and gasoline engines reported, increased from 14,334 in 1900 to 21,525 in 1905, their horse-power from 134,742 to 289,514, and their percentage of the total horse-power employed in manufacturing establishments from 1·3 to 2. When it is recalled that at the census of 1890 the capacity of gas engines in manufacturing establishments was only 8,930 H.P. and is now over 30 times as great, it will be seen that a really remarkable change has taken place.

# ELECTRICAL DRIVING IN TEXTILE MILLS.

Despite the admitted fact that electrical driving in textile plants is fast gaining ground in this country, and that, after most careful comparison with the results obtained with the most modern mechanically driven mills, the controversy as to the relative advantages of electrical and mechanical drives still goes on. As a matter of fact, the advocates of the electrical drive have everything to gain from discussions of this character, providing the arguments used are based on fact.

While no one who has seen them, would think of depreciating the excellent prime movers and mechanical transmissions to be found, for instance, in standard Lancashire cotton mills, yet the fact remains that the most telling argument adduced in their favour is their undoubtedly excellent record for trustworthiness, and we doubt whether even the latter will remain when sufficient time has elapsed to demonstrate in the cotton mill what has been proved in other directions, viz., the reliability of electrical plant.

The mill-owners of Lancashire and Yorkshire, although more often than not Liberal in politics, are well known as most cautious and conservative in all matters concerning their mills.



Brush Three-phase Generating Plant in a Textile Mill.

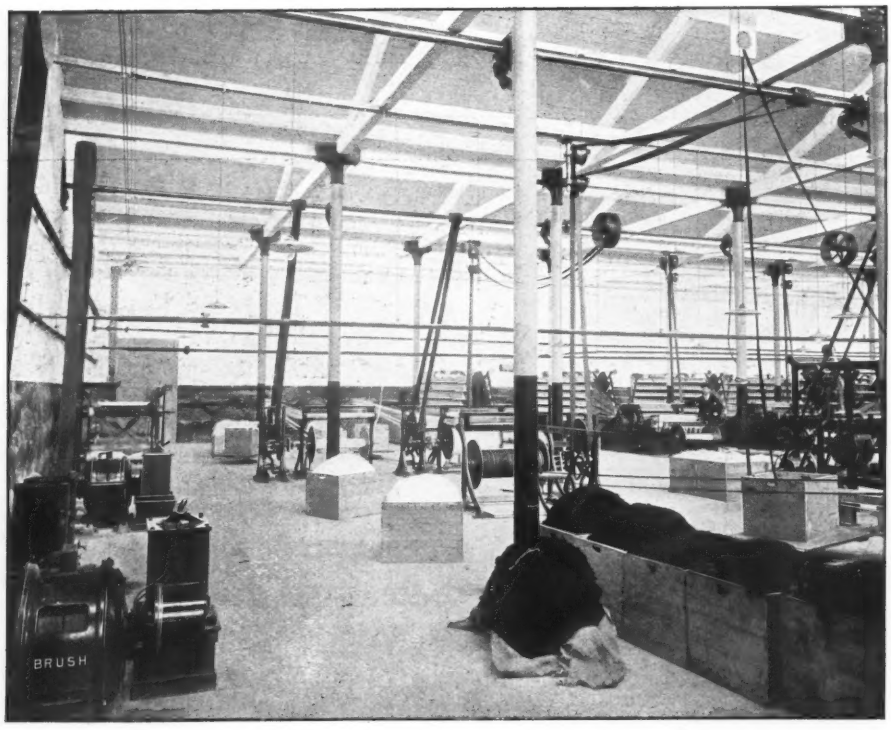
Direct-driven Ring Spinning Frames.

Yet loss of trade in a particular line, due to hostile tariffs, has been known to result in a wholesale replacement of textile machinery to suit new trade conditions, the alternative, of course, being retirement from business.

Thus, although the bogey of installation costs is usually brought forward where a change of drive is under consideration, there is some reason for thinking that the mill-owner will face the bill if the advantage of electrical driving is brought home to him.

Mr. P. Barrett Coulston, in a paper read before the Dewsbury Chamber of Commerce, in May last, pointed out that in mills of small capacity, requiring, say, up to

500 H.P., the cost of a complete electrical installation, including the prime mover (whether engine or turbine), generator, cables, switchboards and motors, will probably be a higher amount than the cost for a mechanical equipment. In the case of mills of larger power, requiring 750 H.P. and over, the two systems of drive entail little difference in initial cost.




Group Driving with Brush Three-phase Motors.

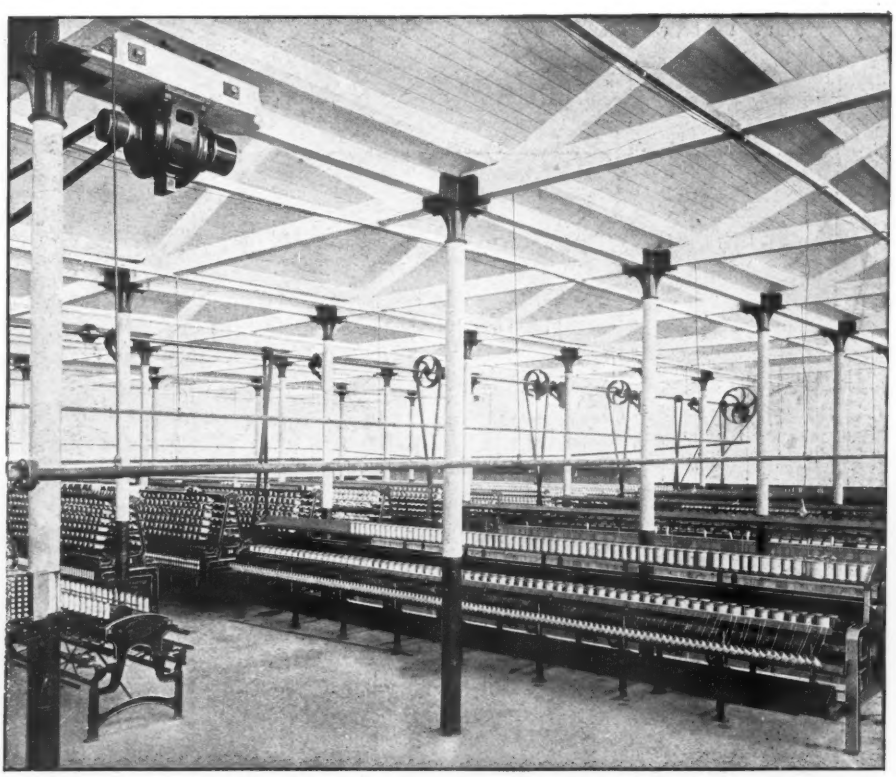
However, with the small powered mills—and they are the most numerous—the installation of electrical generating plant is not a necessity; proximity to a municipal generating plant or power company's station offering to the manufacturer a substitute, which given a trial, would in many cases prove less expensive than the independent drive.

We feel that many municipalities have not appreciated the possibilities of the small mill-owner as a power consumer; in fact, in many cases it requires a boiler or steam pipe explosion, with the threatened complete stoppage of the mill, and the subsequent hurried intervention of the borough electrical engineer with a scratch team of electric motors, to introduce the subject.

The opportunity to give the small mill-owner a trial of electrical driving does not appear to have been sufficiently embraced; such a trial would demonstrate the adaptability of electrical plant, the convenience of the motor where overtime is worked, the possibility of automatically checking the power taken by the textile machinery, and thus detecting faulty working, the reliability of the central station as a source of power supply and many other features.

As regards the advantages of checking the power required by machinery, Mr. Coulston mentions a case where, on starting up a motor, it was discovered that the power taken as shown on the motor meter was 20 per cent. in excess of the calculated amount required by the machines.

The machines were at once overhauled, which resulted in the power required being reduced by no less than 30 per cent. So impressed were the owners by this, that the same procedure was followed throughout the mill with equally favourable results, and a complete electrical installation is now being installed in this mill. It is just in this direction



Winding Machinery, &c., Driven from Overhead Motor.

of power requirements and costs that the smaller mill-owners are unwittingly neglectful, sublimely conscious of their spick and span engine rooms, but ridiculously ignorant as to how the power transmitted from their engine rooms is utilised.

We have not referred so far to the question of increased production arising from electrical driving, although it will probably be the most potent factor in convincing a manufacturer of the expediency of reorganising his mill drive; a case has been cited where the output of a large woollen mill was increased by 15 per cent., and a much improved product resulted from the change, and no doubt improvement will result in nearly all cases due to the more scientific methods of controlling a plant operated by electrical means.

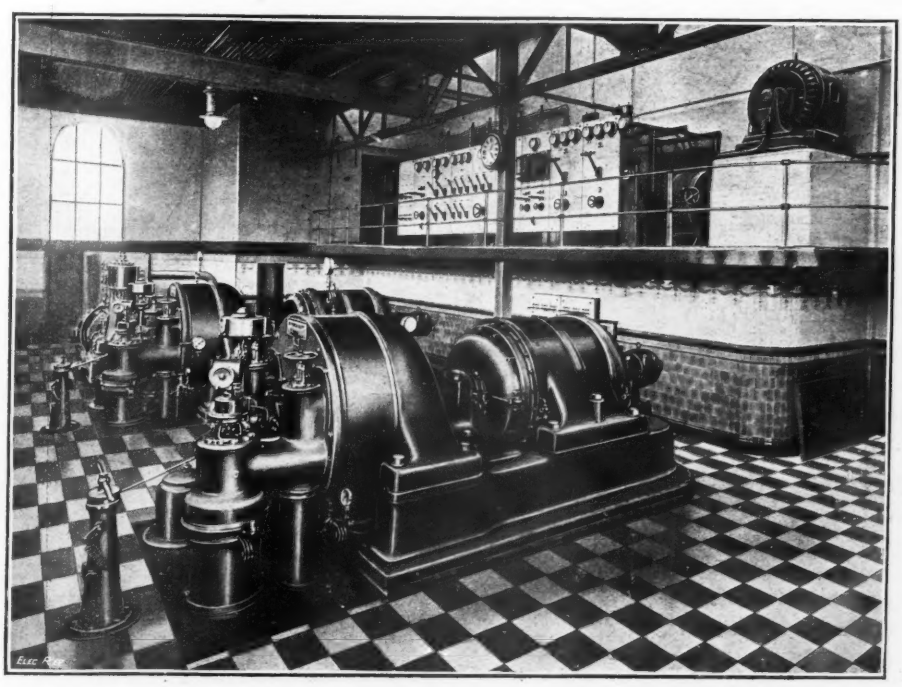
Turning to the larger concerns in which it may be a matter of policy to install independent generating plant, several excellent examples of the completely electrically-equipped mill can now be found in the country. The accompanying views are typical of such installations; those on pages 611 and 612 illustrating an electrically-driven mill, the complete equipment for which was supplied by the Brush Electrical Engineering Co. It will be seen that the power plant includes a Brush turbo-alternator, and that the motors have been disposed for both group and individual driving.

We also illustrate and describe some of the prominent features of a modern electrically-driven spinning mill, lately erected by the Kearsley Spinning Co., Ltd., and equipped by the Electrical Co., Ltd.

The steam-raising plant in this case consists of four Lancashire boilers supplying steam at 200 lb. per sq. in., and superheated to 572° F., this plant working in connection with a battery of economisers, and automatic electrically-driven feed pumps, operated by a ball float on the hot well.

The generating plant consists of two three-phase steam turbo-generators (A.E.G. system), each designed for a continuous output of 750 KW. at 500 volts, and 50 cycles, with a power-factor of 0·8.

Each turbo-generator has its own exciter direct coupled to the main shaft, the excitation pressure being 110 volts; by means of a Tirrill regulator, which automatically adjusts the excitation, the terminal voltage on the generator is kept absolutely constant irrespective of load fluctuations.



[View of A.E.G. Turbo-generating Plant, Kearsley Spinning Co.'s Mill.

Each generator unit is complete with its own independent surface condensing plant, circulating pump and air pump.

Sectional View showing Arrangement of Motors, Kearsley Spinning Co.'s Mill.

The condensers are placed immediately under the turbines, and are designed to maintain a vacuum of 28 in.

The switchboard is specially designed, with all current-carrying parts at the back, the switches being operated by levers passing through the panels; each motor has its independent switch and ammeter on the mainboard.

With the exception of four card-room motors, all the motors for the driving of the mill are placed in a tower at the end of the mill immediately over the turbine house.

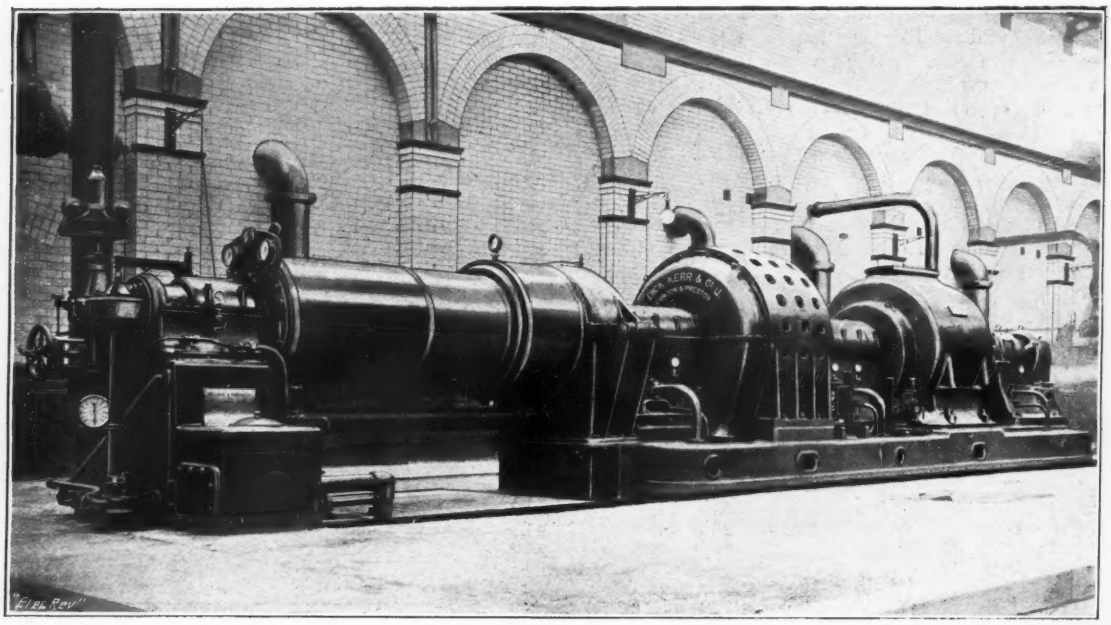
The motors for driving the spinning rooms are of the slip-ring type operated by liquid starters, and each of these motors has its own switchpanel with ammeter, triple-pole switch and no-voltage release. These motors are direct-coupled to the main shaft passing down the full length of the room, and in each case 24 mules of about 1,350 spindles each are driven by one motor, the shaft speed being 485 R.P.M.

Respecting the preparation plant, the cards, drawing frames, &c., are driven by three motors, each coupled to a line shaft; the shaft speed in this case is 360 R.P.M. These motors are of the squirrel-cage type, controlled

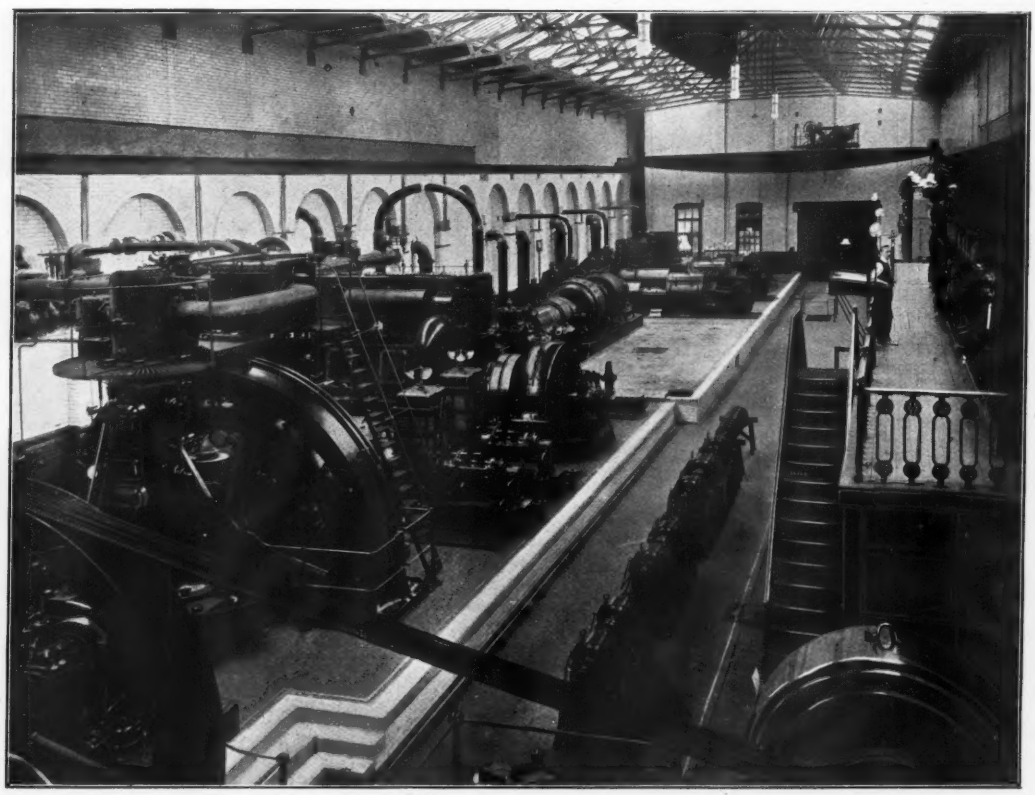
directly from the engine house switchboard by starting transformers, and are enclosed in special housings built into the main wall of the mill, the housing being ventilated by direct access to the outside air. Two separate motors are provided for driving the shafts in connection with the blowing room and flyer frames—*i.e.*, slubbers, intermediates, and rovers, the shaft speed in each case being 485 R P.M.

## ELECTRICAL DEVELOPMENTS AT BLACKPOOL.

We mentioned in our last issue that an important addition to the generating plant installed at the electricity works of this exceedingly progressive sea-side resort was brought into



New A.C.-D.C. Turbo-generator, Blackpool Corporation Electricity Works.



View showing the Old and New Plant, Blackpool Corporation Electricity Works.

There is also a separate motor, speed 720 R.P.M., for driving the bale opener, lattice feeders, &c., in the basement.

The lighting of the mill is carried out independently of the power plant, from a high speed 75-KW. D.C. steam-generator, at 220 volts.

service early last week. Very few electrical men are unacquainted with Blackpool's enterprise in things electrical. The Corpo ation began business with some 30 consumers, with 3,000 8-C.P. lamps connected, 2,000 of them, however, belonging to one consumer alone; its works were opened for

supply on October 13th, 1893, by Lord Kelvin, and the expansion in the electric supply business has been such that to-day some 1,150 consumers, with something like 130,000 8-C.P. lamps, are connected.

Moreover, despite the fact that it is saddled with a season load, and that season during the summer months when lighting hours, from the electricity department's point of view, are at their poorest, yet the undertaking has proved highly successful from a financial standpoint, its net surpluses during the years ending 1905-6-7 being respectively £5,900, £6,120, and £8,229, with average prices ranging from 4d. to 3½d. per unit.

Altogether some six extensions have been made to the plant, which, owing to the period of its existence and the continuous development in plant construction, is of a varied character.

Thus it is that rope-driven Fowler alternators, Ferranti machines, Browett, Lindley triple-expansion engines and steam turbines all rub shoulders in the Blackpool engine house.

However, some eight turbine units figure in the total, the most recent addition being a 1,200-KW., A.C.-D.C. unit of modern type.

The sixth extension is consequent on the increasing demand for electricity for lighting from private consumers, which it is satisfactory to note is yearly extending. On the recommendation of the borough electrical engineer, Mr. Charles Furness, the Electricity Committee decided to install the best possible turbine plant that could be obtained, and after a deputation making a tour of inspection of the latest and largest turbos running in this country, it was decided to install a Willans and Robinson turbine as prime mover, direct coupled to a Dick, Kerr alternator for lighting, and a Brown, Boveri generator for traction. The turbine is capable of meeting loads up to 1,200 KW. without the aid of the steam by-pass valve, and of 1,500 KW. for short periods. The alternator has an output of 800 to 1,000 KW., equivalent to a demand for 33,000 incandescent lamps of 8-C.P., and the Brown, Boveri generator's normal rating is 600 KW., with overloads up to 800 KW. for short periods. It will thus be seen that with one prime mover operating lighting and traction machines, both public services in Blackpool (viz., electric lighting and tramways) will for many hours during the day, and many months during the year, be efficiently and economically dealt with from this new turbine plant, which represents the latest practice in electricity supply. The addition of this machinery has increased the works capacity to 4,150 KW.

Under Mr. Furness, several important alterations have previously been carried out, including a scheme for operating the whole of the plant condensing and erecting a cooling tower on the roof, with a capacity of 250,000 gallons per hour, and these have resulted in material economies in running.

The electric lighting charges have undergone successive reductions, until to-day, with charges of 6d. and 2d. per unit on the maximum demand system, the average price received by the department is 3½d. per unit. Special tariffs, outside peak-load hours, of 1d. per unit, 3d. and 1d. (maximum demand system) per unit for power, and 1d. per unit for heating are available, and every effort is being made to popularise the use of electricity in other directions than lighting. Through the courtesy of Mr. Furness, we are enabled to illustrate the new and old plant at Blackpool.

## Overheard in an Insurance Office.—

CLERK *(seeking for information)* (to electrical expert): What is a milking booster?

ELECTRICAL EXPERT (A.I.E.E.) *(pompously)*: It is an electrical contrivance for attachment to the udders of cows for milking purposes!

SEQUEL.

CLERK *(brimming full of information)* (to client): I see you have a milking booster. Will you kindly tell me if it is in the stable?

CLIENT: I hardly think that it is in the stable. I fancy it is in the cell room.

CLERK: That's rather close quarters for the cow.

**Appointments Vacant.** — A linesman is wanted for Maidstone Corporation tramways department (35s.); shift engineer for Bridlington electricity works (£90); switchboard attendant for Handsworth U.D.C. (25s.).

## CONTRACTORS' COLUMN.

OPENINGS FOR NEW BUSINESS.

ALLOA.—New school at West Grange, E.L. throughout. Kerr & M'Culloch, architects, Alloa.

ALRESFORD (HANTS.).—New infirmary and additions to the workhouse for the B.G. Cancillor & Hill, architects, 12, Jewry Street, Winchester.

BEATH (FIFE).—New school to accommodate Fife Mining Classes. Wm. Birrell, architect, Kirkcaldy.

BECKENHAM.—Extensions to factory in Croydon Road. London Steam Carpet Beating Co., Conlan Street, Kensal Road, W., owners.

BIRKENHEAD.—New disinfecting station for the T.C. (£1,026). Hughes and Stirling, builders, 4, Brazennose Road, Bootle, Liverpool.

BIRMINGHAM (SMETHWICK).—New hotel at Cape Hill. Mitchell & Butler, Ltd., brewers, Smethwick, owners.

BLAIRGOWRIE.—Villa at Rosemount. L. Falconer, architect, Blairgowrie.

BRADFORD (MANNINGHAM).—Free library to be rebuilt by the T.C. (£4,000).

New textile department at the Technical College (£14,000). F. E. P Edwards, city architect.

Extension to laundry in Barnard Terrace, for Bradford Co-operative Society. W. Rycroft, architect, Bank Buildings, Manchester Road, Bradford.

BRECHIN.—Dwelling houses at Bank of Brechin. Mr. Fettis, architect, Brechin.

BRIGHTON.—Extensive additions to motor workshops, electrically equipped, Henry Moore, 67, Preston Street, Brighton, owner.

BRISTOL.—Premises in Prince Street (£3,000). James Murphy, Prince Street, Bristol, owner.

BROMLEY.—Saw-mill electrically equipped (Farwig Lane). H. R. Latter, architect, Town Hall Chambers, Market Square, Bromley, Kent.

BURY.—New Schools for the T.C. (£14,000).

CHELMSFORD.—New public elementary school for the T.C.

CLECKHEATON.—Motor garage in Whitcliffe Road. R. Castle & Son, architects, Bradford Road, Cleckheaton; E. S. Stead, owner.

COALVILLE (LEICESTERSHIRE).—New Council school.

CORK.—Sanatorium (electrically lighted) to be erected at Streamhill. Electrical expert to be engaged by Joint Hospital Board.

COVENTRY (EARLSDON).—Coffee tavern to be converted into a church. Bishop of Worcester.

CREWE.—St. John's Church, Vestry Hall, and Parsonage, to be lit by electricity.

DOUGLAS.—Residence in Strathallan Park, Onchan, for Mrs. H. Lolley. Walter Lolley, The Lindens, Avenue Crescent, Harehills Lane, Leeds.

DUMBARTON.—Free Church. Halley & Neill, architects, Dumbarton.

DUNDEE.—Additions to laundry for directors of Royal Infirmary.

Alterations at dyeworks for Stevenson Bros.

Alterations to shop for Fleming Bros., Cowgate.

Villas in Dalgleish Road for Gavine & Galloway.

ECCLES.—Extensions to Leigh Street Mills, Patricroft. H. Leigh & Sons, owners.

ELTHAM.—Additions to "Clovelly," Southend Road. Whistler & Worge, High Street, Eltham, builder.

Alterations and additions to "Newhaven." J. Jarvis & Sons, 253, Hackney Road, N.E., builders.

FALMOUTH.—Detached residence on Gyllyngdune Estate. H. E. Tresidder, architect, Falmouth; A. W. L. Parsons, owner.

FOLKESTONE.—Club-house for the Golf Club for Lord Radnor. L. G. A. Collins, architect, Manor House, Folkestone.

GILLINGHAM (KENT).—Dust destructor at the electricity works for the T.C. F. C. Boucher, town clerk.

GORTON (MANCHESTER).—New Council School in Thornwood Avenue. W. A. Clegg, secretary, Education Office, Town Hall, Gorton.

GOSPORT.—Extensions at the Secondary Schools (£2,543). C. M. Dash, builder, Clarence Works, Gosport.

GOWERTON (GLAM.).—Extensions to the Intermediate Schools for Glamorgan C.C. (£10,000).

GRAVESEND (MILTON).—New church. E. J. Bennett, architect, 20, Darnley Road, Gravesend; W. H. Archer & Son, builders, The Grove, Gravesend.

HARROGATE.—Alterations at Rosset Holt for W. Wright. T. E. Marshall, architect, James Street, Harrogate.

HAWKSHEAD (LANCS.).—Residence for Miss Holliday. J. Bell, builder Coniston (Lancs.).

HULL.—New works. Reckitt & Sons, Ltd., Hull, owners.

New science buildings at Hymers College for the Governors. J. Bilson, architect, 23, Parliament Street, Hull.

HUDDERSFIELD (KIRKBURTON).—Farm buildings and home for farm worker at the County Asylum, Storthes Hall (£2,914); also installation of laundry machinery at the Asylum (£3,000).

KILTARLITY (INVERNESS).—New Manse for U. F. Church. R. J. Macbeth architect, Queen's House, Inverness.

KIRKCALDY (FIFE).—Important extension of linoleum works for W. Nairn and Co.

New church (£5,000). W. Williamson, architect, Kirkcaldy.

LEICESTER (OADBY).—New almshouses for the Framework Knitters' Co.

LIMERICK.—Central creamery for the Deel Bridge Co-operative Society, Ltd. J. D. Leahy, architect, Newcastle West.

LONDON (COVENT GARDEN).—Rebuilding White Swan public house for Hoar and Co., Red Lion Brewery, Lower East Smithfield, E.

(WESTBOURNE GROVE).—Additions and alterations to 1, Chepsto Place. E. J. Stubbs, 30, Craven Street, W.C., architect.

(BETHNAL GREEN, N.E.).—New Town Hall (£20,000). P. Robinson and W. Alban Jones, architects, Leeds.

(LOWER CLAPTON).—Installation of electricity in works, at Goulto Road, of W. C. Terry & Co., athletic shoe manufacturers, 116, Balls Pond Road, N.

(ST. PANCRAS).—Shop in Mabledon Place. Rupert Richards & Co., 60, Huntley Street, W., builders.

(HACKNEY).—Adaptation of 236, Mare Street, for post office.

(PLUMSTEAD). — New church of St. Michael and All Angels. J. Longley & Sons, Crawley, Sussex.

(PLUMSTEAD).—Club-house and hall at Abbey Wood. W. Wadman, 55, Ommaney Road, New Cross Gate, S.E.

(TOTTENHAM).—Piano factory mill. Lewis Solomon, 16, Union Court, E.C., architect.

(TOTTENHAM).—Shop, office, and flats in High Road. G. L. Wilson, High Road, Lower Tottenham, builder.

(HACKNEY WICK, N.E.).—Additions to Atlas Works. A. Sykes, 45, Finsbury Pavement, E.C., architect.

(HACKNEY WICK).—Additions to premises in Wallace Road, of Achille Serre, Ltd., dyers and cleaners.

(CHELSEA).—Addition to Oratory Girls' School. Johnson, Saul and Co., 26, Thurloe Place, W., builders.

LONDON (W.C.).—Additions (property room and three dressing rooms) to Alhambra Theatre. W. M. Brutton, 42, Ludgate Hill, E.C., architect.

(KNIGHTSBRIDGE).—Adaptation of disused fire brigade station for Incorporated Soldiers' and Sailors' Help Society, 122, Brompton Road, W.

(CATFORD, S.E.).—Two workshops in Brownhill Road. Norfolk and Prior, 4, Station Buildings, Catford, architects.

(TOTTENHAM).—Alterations to Lord Palmerston public house. Bruce J. Capell, 36, Broad Street Avenue, E.C., architect.

(PLUMSTEAD).—Buildings in Vicarage Road. S. A. Douglass, 17, Tilice Road, Plumstead, builders.

(BATTERSEA).—Club-house and Sunday School in Harroway Road. W. & C. A. Bassett-Smith, 10, John Street, Adelphi, W.C., architects.

(WOOLWICH).—Buildings in Kingsman Street. S. Wells & Son, 47, Church Street, Woolwich, builders.

(PLUMSTEAD).—Workmen's club and institute, Francis Street. W. D. Goodwin, 14, Great St. Thomas Apostle, Queen Street, E.C., architect.

LONGFLEET.—Alterations to male imbecile wards at the workhouse, for the Guardians of Poole Union. P. E. L. Budge, clerk, Union Offices, 139, High Street, Poole.

LUDLOW.—Roman Catholic Church. J. Hayes, builder, 96, Longden Coleham, Shrewsbury.

MANCHESTER.—New stations at Styal, Heald Green, Gatley, Didsbury and Withington for the London and North-Western Railway Co. Nayler Bros., builders, 23, Estate Buildings, Huddersfield, and J. Salt (sub-contractor), 30, Market Street, Buxton.

NEATH.—Electrical equipment at Clyne Colliery. Cammell, Laird & Co., Ltd., owners.

NEWCASTLE-ON-TYNE.—Church of St. Lawrence in Walker Road. Architects, Hicks & Charlewood, 67, Westgate Road, Newcastle-on-Tyne.

NORTHAMPTON.—New Town and County School for the T.C. and Northants C.C. (£15,250).

NOTTINGHAM (BEESTON).—Banking premises in Post Office Square. Nottingham and Notts Banking Co., Ltd., owners, Nottingham.

OLDHAM (ROYTON).—New public baths for U.D.C. (£4,000 to £5,000).

PEEL (ISLE OF MAN).—New station buildings for the railway company. H. Cowle, architect, Douglas, Isle of Man.

PENGE.—Building new Town Hall and fire station under consideration by District Council. H. W. Longdin, surveyor to Penge Urban District Council.

PENTRE (PONTYPRIDD).—Church parish hall, Cwmpark. Jacob Rees, architect, Pentre.

PENZANCE (NEWLYN).—Ice factory (£15,000). R. R. Bath, chairman of the company formed.

PERTH.—Additions to property at 10 and 14, Gowrie Street. J. W. Smart, architect, Perth.

PERTHSHIRE.—New Manse at Madderty (£2,000). H. G. Bell, Perth, architect.

PLYMOUTH.—Important extension of Victoria Clothing Factory. Lancaster and Co., Ltd., owners.

PORTSMOUTH.—Extensive storehouses at the gun wharf for the War Office. R. H. B. Neal, Ltd., builders, Princess Square, Plymouth.

RATHFRILAND (Co. DOWN).—Additions to branch premises for the Belfast Banking Co. S. C. Hunter, surveyor, Scottish Provident Buildings, Belfast.

REDCAR.—Extensions at the Redcar and Coatham Literary Institute (£1,000). Moore & Archibald, architects.

ROCHESTER.—Important additions to Bull Hotel, including large motor garage. G. E. Bond, architect, 384, High Street, Rochester; J. T. Snell, owner.

ROTHERHAM (MASBOROUGH).—Congregational Sunday Schools (£1,300). Mr. Totty, architect, Rotherham; W. Beeden, builder, Thrybergh, Rotherham.

SHEFFIELD (NORTON LEES).—Parish and Sunday School buildings (£3,000). Hall and Fenton, architects, 14, St. James' Row, Sheffield.

SILSDEN.—New fire station for the District Council (£1,000).

SOUTHBANK-ON-TEES.—Shipyard, graving docks, &c. Builders, Sir John Aird & Co., Westminster, London; engineer, M. Moncrieff, 116, Pilgrim Street, Newcastle-on-Tyne.

STOCKPORT (REDDISH).—Houses (46) and shops. A. T. Tindall, builder.

STOCKTON-ON-TEES.—New Presbyterian Church in Yarm Lane for St. Andrew's Church. R. F. Brittain, secretary.

STOKE-ON-TRENT.—Extensions at the Workhouse, including midwifery ward, children's homes and laundry for the B.G.

SWANSEA.—Rebuilding 5, College Street. C. T. Ruthen, architect, Bank Chambers, Heathfield Street, Swansea.

Important extensions at Hafod and Upper Bank Works, electrically equipped. Williams, Foster & Co., Ltd., metal smelters and refiners, owners.

Additional buildings at the Technical College. W. James, secretary, Technical College, Swansea.

TEIGNMOUTH (BISHOPSTEIGNTON).—New Wesleyan church. Wills and Sons, architects, Derby.

WADEBRIDGE (CORNWALL).—Block of stores.—Wadebridge Co-operative Co., owners.

WALLASEY.—New grammar school for Cheshire C.C.

WARRINGTON.—Development of estates at Great Sankey and Grappenhall into Garden City. A. Bennett, secretary to the Warrington Garden Suburbs, Ltd., Market Gate Chambers, Warrington.

WEST BROMWICH.—Proposed new laundry in connection with Smethwick and Oldbury Joint Hospital.

WIGAN.—New spinning mill. Pansy Spinning Co., owners.

WILLESDEN.—Addition to Hythe Works, Hythe Road. Hennell & Son, 8, Essex Street, Strand, W.C., architects.

Conversion of Hilburn Grammar School into secondary school (£16,000).

WINDSOR.—Business premises in Thames Street. Hollis & Sons, builders, St. Leonard's Road, Windsor.

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**Cleveland and Durham Electric Power Co.**—The report submitted at the first annual meeting held on the 9th inst. stated that the ordinary shares in this company and the Northern Counties Electric Supply Co. had been acquired at a cost of £611,373, and £28,770 had been expended in the construction and equipment of sub-stations, &c. A loan of £100,772 had also been advanced to the Northern Counties Electric Supply Co. The net revenue for the year was £10,978, and a final dividend of 2½ per cent. was proposed on the preference shares for the 12 months, leaving £3,227 to carry forward.

# CONTRACTS OPEN and CLOSED.

## OPEN.

**Antwerp.**—October 17th. The municipal authorities are calling for tenders for the installation of electric light in the Salle de Fêtes recently erected in the Place de Meir, Antwerp. A deposit of 8,000 francs (about £320) will be required to qualify any tender. Specifications from the Hotel de Ville, Antwerp, at a cost of 0·50 franc. A copy may be inspected by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

**Argentine Republic.**—June, 1908. The municipal authorities of Buenos Ayres are reported to be about to invite tenders for the concession for the construction and working of an underground electric tramway in the city. Tenders will be open until June 1st, 1908, and particulars may be had from the Legation in Paris.

**Australia.**—MELBOURNE.—November 12th. 6,000 dry cells for the Deputy Postmaster-General of Victoria. Commonwealth Offices, 72, Victoria Street, S.W., or Board of Trade Commercial Intelligence Department. Specification can be seen at the offices of the ELECTRICAL REVIEW.

MELBOURNE.—December 10th. Fifty telephones (wall sets). Tenders to the Deputy Postmaster-General, Melbourne, by 3 p.m. on December 10th. Specification may be seen at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C., or at the office of the ELECTRICAL REVIEW. Tenders, forms, &c., may be obtained at the Australian Commonwealth offices in London, 72, Victoria Street, S.W., where also preliminary deposits on tenders may be paid.

NEW SOUTH WALES.—November 6th. Postmaster-General's department. 14½ tons hard-drawn copper wire (300 lb. per mile); 4 cwt. copper binding tape (200 lb. per mile, ⅞ in. wide); 3,500 large insulators (best white porcelain); 1,000 tallow-wood cross-arms, 3 ft. 10 in., complete; 2,500 ditto, 5 ft. 2 in. Specifications and general conditions may be seen at the office of the ELECTRICAL REVIEW.

NEW SOUTH WALES.—December 11th. Tenders will be received at the office of the Deputy Postmaster-General, Sydney, for the supply and delivery, at the Central Exchange, General Post Office, Sydney, of the following: 1,000 telephones, wall, common battery; 100 telephones, table, common battery. Specifications may be seen at the office of the ELECTRICAL REVIEW.

NEW SOUTH WALES.—SYDNEY.—November 6th. The Water and Sewerage Board require tenders for centrifugal pumps and electric motors for the low-level sewerage system of Sydney.

SOUTH AUSTRALIA.—January 8th, 1908. One common-battery switchboard and 3,000 subscribers' telephones (specification No. 166) for the Deputy Postmaster-General, Adelaide. Specifications can be seen at the Commonwealth Office, 72, Victoria Street, S.W.

VICTORIA.—January 7th, 1908. The Postmaster-General requires tenders for 11 sections of a common-battery switchboard and 3,000 subscribers' telephones and other apparatus, for the telephone exchange at Windsor.

ALBANY (W.A.).—November 18th. Tenders are required by the municipal authorities of Albany for the public and private lighting of the town by gas or electricity for the next 15 years. Tenders to Town Clerk, Ernest B. Paton.

**Belgium.**—(No date fixed.) The Belgian State Railways, 11, Rue de Louvain, Brussels, will shortly call for tenders for annual supplies of materials and appliances for lighting trains by electricity.

They also require for Tournai Railway station supplies as follows: (1) 36 iron standards; (2) two switchboards; (3) fittings; (4) insulators; (5) bronze wire, &c.; (6) insulated cable and wire; (7) galvanised iron wire, 7 mm. in diameter, hoisting cable, &c.

The municipal authorities of Flemalle-Haute (province of Liége) have just invited tenders for the concession for the public and private electric lighting of the town.

(No date fixed.) The Molenbeck freezing works require tenders for a complete installation (Glaceries de Molenbeck près de Bruxelles).

**Birmingham.**—October 12th. 49,000 tons of coal for the Corporation Electricity Supply Department. R. A. Chattock, city electrical engineer.

**Egypt.**—November 1st. The Alexandria Harbour authorities require tenders for the construction of an electric power station and for the following plant, to be worked by electric power:—Five transporters of large range; five ditto of smaller range; six

cranes of 4 tons each; 36 cranes of 2 tons each; 25 capstans; cables; feeders, &c. Particulars may be obtained from the Directeur des Postes et Phares.

**Grimsby.**—October 21st. Switchboard panels for the Corporation electricity department. See "Official Notices" September 27th.

**G.W. Railway.**—October 22nd and November 12th. Stores, including a number of electric and telegraph sections, for one year. See "Official Notices" October 4th.

**Italy.**—November 4th. The municipal authorities of Acireale, in the province of Catania, require offers for the installation and working of an electric lighting and power plant, for 30 years. The city will contribute £1,480 per year for 112,278 KW.-hours, and the company must deliver any further energy required for lighting at 3½d. per KW.-hour. A deposit of £160 is required. Tenders are to be made to the Sindreo, and the amounts and names are to be considered strictly confidential.

**Limerick.**—October 15th. Switchboard extensions for the Electricity Department. See "Official Notices" October 4th.

**Marylebone.**—October 16th. Arc lamp carbons for the Electricity Department. See "Official Notices" to-day.

**New Zealand.**—December 11th. The Napier T.C. requires tenders for electric tramways, lighting and power supply. Frank N. Bower, Town Clerk.

**Paris.**—October 24th. The Municipal Waterworks Department (Service des eaux, canaux et égouts) requires tenders for the supply and erection at the Austerlitz works of (1) four sets of motor-driven pumps, dynamos, &c., complete, capable of lifting 100,000 cubic metres of water per day into either of two reservoirs, or 50,000 cubic metres into both at the same time; (2) and one reserve set; (3) 10 boilers in two groups of three, and one of four. Particulars may be obtained at the Hotel de Ville.

**Portrush.**—November 2nd. Lighting installation (electricity or gas) for the U.D.C. Specifications prepared by Mr. J. Woodside, A.M.I.E.E., may be seen at the offices of the Council, Town Hall.

**Rochdale.**—October 19th. Steam dynamo for the Corporation electricity works. See "Official Notices" to-day.

**Spain.**—MADRID.—October 15th. The Post and Telegraph Department require tenders for the exploitation during 10 years of the urban telegraph system of Sevilla. A royalty of 10 per cent. is required by the Government, also a bond of 20,000 pesetas. Particulars may be obtained advisably through an agent making personal application at the Direccion General de Correos y Telegrafos, 10, Carretas, Madrid.

MADRID.—October 17th. The Post and Telegraph authorities require tenders for the exploitation of the Alicante telephone system. The bond is 10,000 pesetas. The remarks on the Sevilla tender apply also in this case.

MADRID.—October 18th. The Post and Telegraph authorities require tenders for the exploitation of the urban telephone system of Valledolid during the next 10 years. A 10 per cent. royalty will have to be paid, and a deposit of 10,000 pesetas is required. Particulars may be obtained from the Direccion General de Correos y Telegrafos, 10, Carretas, Madrid.

PONTEVEDRA.—October 29th. The municipal authorities require tenders for installation and working of electric lighting in the town &c., for 20 years. Particulars may be obtained from the Ayuntamiento Constitutional.

TORO.—October 30th. The municipal authorities require tenders for the installation, maintenance, &c., of public and private electric lighting for 10 years. Particulars may be obtained from the Ayuntamiento Constitutional, to which authority tenders are to be addressed.

**Stepney.**—November 11th. Steam and electric generating plant, &c., for the Blyth's Wharf generating station, and the sub-station equipment, for the Council. See "Official Notices" to-day.

**Tunbridge Wells.**—November 1st. 500-KW. turbine, alternator and exciter, surface condensing plant and pipe-work for Corporation electricity works. See "Official Notices" Sept. 27th.

**Warrington.**—October 22nd. Paper-insulated cables for the Electricity Department. See "Official Notices" to-day.

**Wrexham.**—October 22nd. One 50-KW. steam set for Electricity Department. See "Official Notices" to-day.

## CLOSED.

**Aldershot.**—The U.D.C. received the following tenders for the supply of cable, bitumen, troughing and insulators:—

| | |
|---|---|
| Callender's Cable and Construction Co., Ltd. .. | (accepted) £445 |
| W. T. Henley's Telegraph Works Co., Ltd. .. .. .. | 460 |
| Geipel & Lange .. .. .. .. .. .. .. | 472 |
| British Insulated and Helsby Cables, Ltd. .. .. .. .. | 467 |
| St. Helens Cable Co. .. .. .. .. .. .. | 486 |
| W. T. Glover & Co., Ltd. .. .. .. .. .. .. | 475 |
| Siemens Bros., Ltd. .. .. .. .. .. .. | 457 |
| Western Electric Co. .. .. .. .. .. .. | 483 |
| Johnson & Phillips, Ltd. .. .. .. .. .. | 452 |

**Bristol.**—At Tuesday's Council meeting the Electrical Committee reported they had entered into the following contracts:—

Veritys, Ltd.—Direct-current motors for hiring purposes, at £613.
Babcock & Wilcox, Ltd.—Extension of coal conveyor, Avonbank, at £453.

**Beckenham.**—The U.D.C. has accepted the following tenders for supplies to the electricity works:—

Lucy & Co., Oxford, lead service boxes, 8s. each.
Cable Accessories Co., Tividale, Tipton, H.T. three-way boxes, £4 10s. each; H.T. straight-through boxes, £2 15s.
Johnson & Phillips, frames and covers, 8s. 3d., 6s. 3d., and 5s. 3d. each; three-way boxes, £3; four-way boxes, £3 19s. 3d.; three-way boxes with frames and covers, £5 10s. 6d.; four-way ditto, £6 6s. 9d.; double disconnecting service boxes, £1 1s.; two-wire house-service cut-outs, 7s. 6d. per set.
Bishop & Austin, London, non-disconnecting service boxes, 12s. each.

**Dundee.**—On October 2nd the Electricity Committee resolved to recommend the acceptance of the following tenders:—

Willans & Robinson, Ltd.—Electric generating plant for new power station, £19,200.
Babcock & Wilcox.—Boilers, &c., £14,735; brick settings, £2,125.

The tender of Messrs. Chamberlain & Hookham, amounting to £447, for meters was accepted.

In regard to the plant tenders, the Committee generally approved of these offers, but it was remitted to Mr. Don, the convener, and Mr. J. M. Nairn, along with the engineer, to visit Glasgow and other places for the purpose of seeing certain types of machines before coming to a decision, with powers to select the types of machines and accept the tenders most advantageous to the Council.

**East Ham.**—The T.C. has accepted a quotation from Callender's Cable and Construction Co., Ltd., at £363, for the supply of an additional feeder cable to be laid along High Street, south, from Nelson Street to the Rancliffe Road.

**Halifax.**—The B. of G. has accepted the tender of Mr. J. Hamer, Broad Street, Halifax, for the supply of electrical fittings for six months.

**London.**—STEPNEY.—The Electricity Committee received the following tenders for a coal bunker and conveyor required in connection with the marine type boiler at the generating station:—

| | |
|---|---|
| Babcock & Wilcox, Ltd. .. .. .. .. | £325 |
| W. Badger .. .. ..(provisionally accepted) | 253 |
| Richmond & Co. .. .. .. .. .. .. | 266 |
| Fulham Steel Works Co. .. .. .. .. | 270 |
| Underfeed Stoker Co. .. .. .. .. .. | (informal) |
| W. & L. Cole, Ltd. .. .. .. .. .. | 320 |

L.C.C.—The Highways Committee of the L.C.C. have accepted the tender of Smith & Coventry, Ltd., amounting to £800, for the supply of two high-speed vertical tire boring mills for the central car repair depôt; and that of Buck & Hickmann for the delivery of a high-speed vertical milling machine, for the sum of £292 10s. Permission has been given to the latter company to sub-let the work under its contract to Smith & Coventry.

MARYLEBONE.—The B.C. has accepted the tender of Messrs. W. Cory & Son, Ltd., for the supply of coal for six months, at the following prices, delivered by barge:—High hazel double-screened nuts, 14s. 11d.; Nuneaton, 14s. 11d.; Shipley, 14s. 11d.; Griff peas (for limited quantity to be agreed), 13s. 3d.

BATTERSEA.—The two 10-H.P. motors at present in use in the Battersea public wash-houses having been found insufficient, the B.C. communicated with the British Thomson-Houston Co., and they agreed to substitute two 20-H.P. motors, with suitable starters, for £196, and to allow £100 for the existing motors, the original cost of which was £100 12s. This offer was accepted.

WOOLWICH.—The B.C. has received the following tenders for building alterations at the Globe Lane electricity works in connection with the installation of three Davey-Paxman boilers:—J. Smith & Sons, £657, time 2½ months; Thomas & Edge, £637, time 1½ months; borough engineer, £620, time 3 months; B. E. Nightingale, £536, time 6 months; Kirk & Randall, £502, time 3 months; W. Neil & Co. (accepted), £485 18s., time 2 months.

**Manchester.**—Messrs. Sewell & Varley have secured the contract for the complete installation of electric light for the Co-operative Insurance Society's new offices in Corporation Street.

**Norfolk.**—The C.C. has accepted the tender of the Tudor Accumulator Co., Ltd., for additional storage for electric batteries at the Asylum, at £885, with £54 cost of maintenance.

**West Bromwich.**—The T.C. has accepted the tender of Messrs. Thos. Parker, Ltd., of Wolverhampton, for the supply of a combination booster.

**West Ham.**—The Board of Guardians has accepted the tenders of the General Electric Co., Neville, Williams & Co., Pryke & Palmer, Risdon, Lock & Co., Ltd., and Troup, Curtis and Co., for the supply of electrical fittings for a year.

**Whitehaven.**—Messrs. Ramsay Bros., of Whitehaven, have secured the contract for electric light wiring at new houses being erected at Herbert Hill, Whitehaven.

## FORTHCOMING EVENTS.

Engineering and Machinery Exhibition at Olympia. Open until October 19th.

**To-day's Events** (Friday, October 11th).—At 5.45 p.m. At the Institute, St. John Street, Clerkenwell. Meeting of the Northampton Institute Engineering Society. Address on "The Scope and Future of Engineering," by Dr. C. V. Drysdale.

Saturday, October 12th.—At 2 p.m. At the Wood Memorial Hall, Newcastle-on-Tyne. Meeting of the North of England Institute of Mining and Mechanical Engineers.

Monday, October 14th.—Meeting of the Institution of Mechanical Engineers, Graduates' Association. Paper on "Modern Locomotive Practice," by Mr. A. MacKinnon.

Thursday, October 17th.—Rugby Engineering Society. Lecture by Mr. E. R. Briggs (past-president) on "Steam Turbines, with special reference to the Willans-Parsons type."

Friday, October 18th.—At 8 p.m. At Institution House, Storey's Gate, St. James's Park. Monthly general meeting of the Institution of Mechanical Engineers. Paper on "The Indicated Power and Mechanical Efficiency of the Gas Engine," by Prof. B. Hopkinson.

At 7 p.m. At Westminster Palace Hotel. Annual general meeting of the Junior Institution of Engineers, followed by meeting of the Benevolent Fund.

At 9 p.m. In the Theatre of the Royal Institution. Extra meeting of the Chemical Society. Prof. Emil Fischer, F.R.S., will deliver the Faraday Lecture, entitled "Organic Synthesis and its Relation to Biology."

Friday, October 25th.—At 5 p.m. At Royal College of Science, Imperial Institute Road, S.W. Meeting of the Physical Society.

## NOTES.

**Electric Shock Fatalities.**—As mentioned on page 579 of our last issue, an electric shock accident in which one John Brennan, a blacksmith, was killed, occurred recently at Wednesbury. At the inquest which was held on October 1st, Mr. G. S. Ram was present to watch the proceedings on behalf of the Home Office, and the Patent Shaft and Axletree Co. were represented.

Josiah Watts, a striker at the works, explained that he was working with deceased. They went to an electric saw with a piece of hot metal, which Brennan carried on some tongs. Deceased put the metal on the saw, and just as he was pulling back, witness heard him shout, and saw him reel. Witness made an attempt to save deceased by running to his assistance, but he was thrown down, and a man named Costello pulled him on to some coals.

Replying to Mr. Ram, witness said he got a shock himself.

The Deputy Coroner: You fell on the burning plate?—Witness: No; the plate wasn't so hot.—The Deputy Coroner: Then how did you burn your arm?—Witness: I don't know, unless it was by the electricity.

The Deputy Coroner: Was there a great flame of electricity?—Witness: Yes; there was a fearful flame about.

Continuing, witness said at the time he was only 3 or 4 ft. away from the switch. The deceased man put the switch in, and Costello pulled it out. They were all, he added, accustomed to go to the switch.

Edward Corbett, blacksmith, gave corroborative evidence. He heard Brennan shout "Ted," and "Oh! Oh!" and he immediately ran to his assistance, and tried artificial means of respiration, but the man appeared to be dead the moment he got to him. Dr. Garman came, and pronounced life to be extinct. The switch was worked before the same night, and it was then all right. Witness did not know how often it was tested.

By Mr. Ram: Witness was sure that the shock came on immediately the switch was pulled off.

Harry Weaver, an electrician employed at the works, spoke to hearing of the accident, and to rushing to the sub-station and pulling out the switch that controlled the part of the works where the accident happened. Then he went into the bogie shop, and saw deceased and Costello lying on the ground. At the time he heard of the occurrence he was only about 12 yds. from the switchboard.

John Andrews, electrical engineer in charge of the plant at the works, said he was not in the works at the time of the accident. He had examined the electrical apparatus, and found that the spring which made the contact inside the switch box was broken, and that had left one of the blades still in contact. The base was not perfectly earthed. The motor and machines were perfectly earthed. Deceased was standing on concrete at the time, which would make the connection to earth. In the opinion of witness, the current went through the saw to the deceased, and he earthed it; not from deceased to the saw. Replying to Mr. Beale, witness said that everything had been done in accordance with the Home Office requirements.

Mr. Ram gave evidence. He said there was nothing to account for the accident except some paint between deceased and the bolt and column. He thought the electricity did not flow away into the ground, because at that particular spot the earth was very dry, and consequently non-conductive. Replying to questions, witness said at present there were no electrical regulations in force, but the Home Office had some before them in draft form. Iron covers were universally used in these cases, but witness admitted that if there had been a wooden cover the accident would not have happened, although there was always a danger of wood firing. The accident might have happened if there had been a leakage with the motor. No shaft contact would have saved it. There was something to be said both in favour of and against iron covers, and in his recommendation to the company he never suggested what the covers should be made of. He considered the company had taken all reasonable precautions in the matter.

The jury returned a verdict of "Accidental death," adding that they did not consider anyone was to blame in the matter, as all reasonable precautions seemed to have been taken.

The foreman (Mr. Fennell) said, unfortunately, those precautions were not sufficient, but the jury felt they could leave it in the hands of the company to make such arrangements that the earth connection in the future would be more perfect.

On Tuesday morning, last week, a woman committed suicide by throwing herself on the live rail of the N.E.R.'s electric section at Benton, near Newcastle.

**The L.C.C. Greenwich Station.**—The Highways Committee presented a report at Tuesday's meeting in reference to the conclusions of the Admiralty Committee on the working of the power station at Greenwich in its relation to the Royal Observatory. It appeared that the Admiralty were prepared to accept the conclusions of the Special Committee. The Highways Committee saw no reason why the County Council should not undertake to give effect to the report, on the understanding that the whole of the matters dealt with in the recommendations 1, 3, 4, 5 and 6, might be reviewed in the light of working at the expiration of two years. The second recommendation was:—"The generating plant for the second portion to be turbines which, as well as the dynamos, must be of a perfectly balanced type, such as has been proved by trial not to cause vibration." On this matter the Highways Committee stated that they had pointed out to the Admiralty that the Council was already doing its utmost to comply strictly with this recommendation, and that every step was being, and would be, taken with the object of securing perfect balance of the revolving parts of the plant ordered for the second portion of the station, and an absence of vibration when the plant was working; and that the same course would be adopted for the remainder of the plant for that portion of the station, when obtained. As to the height of the two chimneys of the second portion, the Committee proposed to arrange for the remainder of the work to be carried out so as to meet the recommendation of the Special Committee, namely, for the chimneys not to be higher than 204 ft. above Ordnance datum, instead of 272 ft., as was originally contemplated.

**Electric Supply Cricket League.**—From Mr. A. W. Seabright, 19, Cadogan Gardens, S.W., the hon. secretary of this League, we have received particulars of the points scored during last season by the clubs affiliated to the League, from which it will be seen that the St. James' and Pall Mall Electric Cricket Club are the winners of the cup this season:—

| | |
|---|---|
| St. James' and Pall Mall Electric C.C. ... ... | 17 |
| St. Pancras Electric C.C. ... .. ... ... | 13 |
| Kensington and Knightsbridge Electric C.C. ... | 13 |
| St. Marylebone Electric C.C. ... ... ... | 9 |
| Central Electric C.C. ... ... ... ... | 8 |
| Chelsea Electric C.C. ... ... ... ... | 0 |

Mr. Seabright will be pleased to furnish electric supply cricket clubs with any information they may desire concerning the League.

**Visit to German Gas Engine Installations.**—On Monday last a party of about a score of British engineers departed for Germany to inspect a number of large gas engine installations. The visit has been organised by Mr. Leonard Andrews and his colleagues of the Key Engineering Co., Ltd., in conjunction with Messrs. Ehrhardt & Sehmer, of Saarbrucken, the well-known builders of steam and gas engines, &c. The installations to be visited include the Homecourt Ironworks, the Government mines at Heinitz, the steel works at Neunkirchen, Messrs. Ehrhardt and Sehmer's works, Messrs. Lahmeyer's, and the Hoesch Iron and Steel Works, Dortmund. Large engines driven by blast-furnace and coke-oven gas, electrically driven rolling mills, &c., form the special features of the programme, which is designed to bring home to British central station engineers and others the advanced state of the large gas engine in Germany. The tour closes to-day. The party includes Prof. Unwin, Central Technical College, South Kensington; Mr. S. E. Fedden, city electrical engineer, Sheffield; Mr. C. S. Vesey Brown, consulting engineer; Mr. Llewellyn Preece; Mr. E. T. Ruthven-Murray, engineer-in-chief, North Metropolitan Electric Supply Co.; Mr. H. Bell, city electrical engineer, Hull; Mr. W. Handcock (Messrs. Handcock & Dykes); Sir Vesey Strong; Mr. A. Clough, resident electrical engineer, Liverpool; Alderman Smith, deputy chairman, Electric Light Committee, Liverpool Corporation; Mr. T. Roles, city electrical engineer, Bradford; Mr. Edw. W. Cowan (Messrs. Cowans, Ltd.); the representatives of half a dozen technical journals, including the ELECTRICAL REVIEW; and Mr. Leonard Andrews and Mr. R. B. Slacke, of the Key Engineering Co., Ltd.

**Apprenticeship Systems and Workshop Practice.**—Several articles have appeared recently in American technical journals dealing with the apprenticeship question and also with piecework and bonus systems. As, however, there is a considerable amount of repetition in American papers, as has been pointed out before in these columns, we are contenting ourselves with merely giving brief summaries of some of the more practical articles, so that our readers who are specially interested in the subject may turn up for themselves the originals of those which appeal to them.

"The Improvement of Opportunity for the Young Workman," by G. F. Stratton, *Engineering Magazine*, August, 1907. Mr. Stratton shows that under modern workshop conditions the apprentice or young workman learns practically nothing except the handling of one or two machine tools, and the more expert he becomes in the handling of a particular machine, the more likely he is to be kept at it. He points out that a man can be taken off the street and put on a lathe or planer, and earn as much money on piecework after about two months' practice as a man who has spent five years in learning the trade. The author then gives a short description of the modern form of apprenticeship as adopted, say, by the Westinghouse or General Electric Co., of America, a system which has been previously described in these columns. He also recommends the correspondence system of technical teaching, and thinks that an apprentice who goes in for such a system of education can lift himself out of the ranks of machine operators to something better and more profitable.

"Some Apprenticeship Experiences in England," by J. Vose, *American Machinist*, July 6th, 1907. The author describes the rough and ready methods adopted in a Bolton machine shop in which he served part of his time. He says that the only direct instruction in lathe work he received was from the blacksmith, who gave him a lesson or two on the use of the T-handled "hook tool", and during the process he received a few smart knocks under the chin from the tool handles. After giving some very interesting reminiscences of the very lax methods adopted, he concludes by questioning whether any "more orthodox system" would have given better results at smaller cost.

"A Square-Deal Premium System," by Daniels, *American Machinist*, June 15th, 1907. In this article the author discusses in a general way the fixing of rates for premium systems, and argues that the masters should not look at the premium system too much from their own point of view, as a man will not go at maximum speed the whole time unless he also is getting something out of it.

"The Taylor Bonus System of Paying for Labour." Editorial. *American Machinist*, June 29th, 1907. It is pointed out that the Taylor system differs from the premium system in that it is the result of an elaborate study of the work by experts, who settle all the details and the workman is then given such minute instructions as to leave him no opportunity for initiative. In the ordinary premium system initiative on the part of the workman is an essential feature, and he is left to make as much as he can in his own way. The *American Machinist* can see neither rhyme nor reason in the Taylor system, because the workman is given the most specific instructions what to do, and is then rewarded by an increase in wages for simply obeying orders; whereas, seeing that a considerable amount of time and money has been spent by the management in elaborating the details, it is the management which is entitled to any improvement which is obtained. The fundamental idea appears to the *American Machinist* to be unsound.

"The Apprenticeship Question: The Cadillac System." *American Machinist*, July 6th, 1907.—The system adopted by the Cadillac Motor Car Co., of Detroit, is described by C. M. Carson and Herman Fletcher. According to this system, a mechanical instructor, who is a practical machinist and tool-maker, is set apart to instruct the apprentices, each of whom he visits each day, and is responsible for their training. He advises them as to what mechanical works to read and what classes to attend. The company expect their foremen to be so busy getting out work that they have no time left in which to instruct apprentices. The instructor, however, works in harmony with the foreman in regard to speed of tools, &c. Lectures are given every four weeks with particular reference to the special class of work turned out. The apprenticeship course consists of two years of 300 days, or 3,000 hours each. The course is divided up into periods as follows: 4 months' drill-press work, 4 months' milling-machine work, 6 months' lathe work, 4 months' bench work and engine assembling, 4 months' bench and chassis assembling, 2 months' testing and driving. The wages are 10 cents an hour for the first six months, 11 cents for the second six months, 12 for the third six months, and 14 cents during the fourth six months. Each apprentice who finishes the course in a satisfactory manner is given a cash sum of $100 over and above his wages.

**Electrical Horticulture.**—Dr. E. H. Cook, the chairman of Bristol Education Committee, has devoted attention to the subject of an increased power of germination in seeds, either with low or high-tension currents. Apart from the increased rapidity with which growth started, Dr. Cook was unable to satisfy himself that the passage of low-tension current through the soil made any difference to the plant. By an overhead discharge of very high-tension current (up to 45,000 volts) he obtained a continued increase in the rate of growth. At Bitton, Mr. J. E. Newman during 1905 made a practical test at the Golden Valley Nurseries. The electricity was derived from a machine of the Wimshurst type; one conductor was earthed, the other was connected with a system of aerial wires running through greenhouses and over garden plots about 16 in. above the top of the plants. To these aerial conductors at short intervals short pointed bits of wire were connected to facilitate discharge. The points were towards the ground. An oil engine kept the electrical machine running for 108 days, about nine hours a day. Cultivation in other greenhouses and in other plots was carried on under normal circumstances for the purposes of comparison. The results of electrification were remarkable. They are recorded as follows:—"Cucumbers, 17 per cent. increase. Strawberries (five-year plants), 36 per cent. increase. Strawberries (one-year plants), 80 per cent. increase, and more runners produced. Broad beans, 15 per cent. decrease, but ready for picking five days earlier. Cabbages (spring), ready for picking ten days earlier. Celery 2 per cent. increase. Tomatoes, no difference. One point requires special mention in the case of the cucumbers grown in the houses. On May 8th a spot disease, of bacterial nature, appeared in all the houses, and unquestionably made far more headway in the unelectrified houses. It seems probable that the ravages of the disease were largely inhibited by the electrical discharge, for during one week, when the influence machine broke down, the disease progressed far more rapidly under the wires, and was again checked upon restarting the machine. The action of electric discharge may be due to one of the causes, either the resisting properties of the host have been increased, or the attacking power of the parasite diminished."

**American Electrical Industry.**—The London *Tribune* says:—"Manufacturers of electrical appliances in various parts of the United States are said to be suffering from a wave of depression. Owing to lack of orders, the General Electric Co., of Schenectady, has discharged many of its employés."

**Institution and Lecture Notes.**—RUGBY ENGINEERING SOCIETY.—The following is the syllabus of meetings arranged by this Society for the new Session:—

October 17th.—Lecture on "Steam Turbines, with Special Reference to the Willans-Parsons Type," by Mr. E. R. Briggs (Past President).
November 21st.—Paper on "The Diesel Engine," by Mr. A. E. Thompson (member).
December 12th.—Lecture on "Textile Electric Driving," by Mr. Jno. Shaw (member), of Manchester.
January 16th, 1908.—Paper on "The British Locomotive," by Mr. A. W. S. Graeme (member).
February 13th.—Paper on "Mechanically-Propelled Commercial Vehicles, with Special Reference to the Petrol Electric System," by Mr. Bernard Hopps (member).
March 12th.—Paper on "The Systematic Design of Lines of Direct Current Machines, in Relation to the Use of Commutating Poles," by Messrs. H. O. Eurich and F. P. Whitaker (members).

There are also to be visits to works as follows:—

October 19th.—To the Sewage Disposal Works and Electric Transmission Scheme of the Birmingham Tame and Rea District Drainage Board.
November 2nd.—To the Acme Spinning Mill—the first complete electrically-equipped mill in the United Kingdom; also to the Stuart Street Generating Station of the Manchester Corporation.
December 7th.—To the Park Royal Generating Station and Hammersmith Car-Sheds of the Great Western Railway.
February 1st.—To the Summer Lane Generating Station of the Birmingham Corporation.

METROPOLITAN TRAMWAY MANAGERS.—The quarterly meeting of the Metropolitan Association of Electric Tramway Managers was held on Friday, 4th inst., when a visit was paid to Croydon. The members attending were:—Messrs. H. E. Blain, West Ham Council Tramways; T. B. Goodyer, Croydon Corporation Tramways; W. E. Hammond, Metropolitan Tramways, Ltd.; G. Ratcliffe Hulme, South Metropolitan Tramways; H. L. Howard, Barking Council Tramways; C. Mittlehausen, Bexley Heath Council Tramways; F. Schofield, Leyton Council Tramways; A. H. Shaw, Ilford Council Tramways; and W. Ullmann, East Ham Corporation Tramways.

Sir J. Clifton Robinson, of the London United Tramways; Messrs. A. L. C. Fell, chief officer, and A. K. Bruce, traffic manager of the L.C.C. Tramways; A. Coveney, Erith Tramways; and Messrs. Murray and Spurr, Walthamstow Council Tramways, were prevented from attending. Mr. T. B. Goodyer, tramways manager to the Croydon Corporation, met the visitors at East Croydon station, and having placed a special car at their disposal, took them for a run over a part of the system. The Thornton Heath depôt, workshops and stores were inspected, and subsequently a meeting was held in Mr. Goodyer's office, when business matters were discussed. Mr. H. E. Blain was unanimously elected chairman in succession to Mr. Fell, whilst Mr. Goodyer succeeded Mr. Blain as hon. secretary. At the conclusion of the business the members were entertained to a knife and fork tea by Mr. Alderman Trumble, J.P., chairman of the Croydon Corporation Tramways Committee.

SOCIETY OF ENGINEERS.—On Monday last a paper on "Liquid Fuels for Internal Combustion Engines," was presented by Robert W. A. Brewer, A.M.I.C.E. The author pointed out the advantages of the adoption of large "heavy oil" engines for marine purposes as compared with gas-producing plant and gas engines. He also gave the results of a number of experiments he had made during the last two years upon petrols of various densities, and mixtures of petrol and paraffin. Some results of the author's experiments with benzol and alcohol were given in tabular form. Alcohol was tested when mixed with a proportion of another liquid fuel and without any alteration to the engine. The results obtained showed great promise for this fuel.

LIVERPOOL AND DISTRICT ELECTRICAL ASSOCIATION.—On Saturday last the members of this Association paid a visit to the Widnes and Runcorn Transporter Bridge. The party were received by Mr. John Henderson, the general manager. After an inspection of the power station, the party proceeded for a detailed round of examination of the construction of the bridge proper, ascending into the towers, and also on to the girders. A trip was then made across the river and back by the transporter car.

THE JUNIOR INSTITUTION OF ENGINEERS.—On the invitation of the organising managers, Messrs. Bridges and Smith, a large number of the members of this Institution recently visited the Engineering

and Machinery Exhibition at Olympia. Divided into groups, they were shown round by Dr. Hele-Shaw, F.R.S., and Messrs. John Bilbie, W. H. Cock, Thos. How, and Capt. H. Riall Sankey, members of the hon. advisory council, who, owing to the limited time at disposal, made a point of directing attention only to the exhibits that are of special interest. Sir Alex. B. W. Kennedy, as president of the Exhibition, subsequently addressed the party in one of the rooms, where afternoon tea was partaken of on the invitation of Mr. Geo. B. Woodruff, member of the Institution.

## OUR PERSONAL COLUMN.

*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*

**Central Station Officials.** — The Newcastle-under-Lyme T.C. has increased the salary of Mr. A. de Renzi, electrical engineer, and that of Mr. J. A. Whittingham, of the electricity staff

Mr. E. E. Hamer, shift engineer at the Gillingham (Kent) municipal electricity works, has resigned.

The Rotherham T.C. has increased the salary of Mr. E. Cross, borough electrical engineer, from £350 to £400 per annum.

The General Purposes Committee of Wolverhampton T.C. has recommended that the salary of Mr. Shawfield, electrical engineer, be increased by £75 per annum forthwith, with a further increase of £75 a year hence.

Mr. H. G. Wright has just left the electricity works, Guernsey, and has been appointed shift engineer to the electricity works at High Wycombe, where he commenced his duties on October 1st.

Mr. Bendix, switchboard attendant at West Ham, has been promoted to the position of assistant shift engineer, and Mr. Delves, improver, has been appointed to the vacant position.

It was announced at the Accrington T.C. meeting on Monday that over 400 applicants had put in for the vacancies as shift engineers at the electricity works. The three appointed were Mr. Fredk. C. Whitehead, of Keighley; Mr. John Scott, of Stockport; and Mr. E. G. Hodgkinson, of Larbert, N.B. Mr. Wareing called attention to the claims of Mr. Hall, of the Corporation's electricity works, to one of the engineers' posts recently advertised by the Electricity Committee, and said that Mr. Hall was competent to do the work, although three strangers had been appointed. The Mayor said the Committee admitted Mr. Hall's ability, but he was only 22 years of age, and the Corporation wanted more experienced men—not less than 28 years of age. Mr. Wareing moved, and Mr. Crawford seconded, an amendment that the minutes be referred back for reconsideration. The amendment was lost.

**Tramway Officials.**—The employés of the Norwich Tramway Co. on Friday presented a pair of silver vegetable dishes and a case of silver and ivory fish knives and forks to Mr. Alan N. Bannister, engineer and manager, on his marriage.

**General.**—An American Exchange says that the John Scott legacy medal and premium of the Franklin Institute of Philadelphia has been awarded to Prof. J. A. Ewing, F.R.S., and Mr. L. H. Walter for their method of detecting electrical oscillations.

The Bradford Education Committee has appointed Mr. W. G. Griffiths, B.Sc., of Exeter, as lecturer in Electrical Engineering at the Technical College, at a salary of £200 per annum.

A pleasant function took place on September 11th at the Royal Hotel, Durban, when Mr. Arthur Wright, who, it will be remembered, has been on a visit to South Africa, in connection with Victoria Falls Co.'s scheme, was entertained by representatives of the electrical engineering profession. Mr. J. Roberts, borough electrical engineer, was in the chair, supported by Mr. F. W. Mills, Government electrical engineer, as vice-chairman. Mr. Wright sailed the next day for England along with Mr. H. Spengel, manager of the Brakpan (Transvaal) Electricity Works.

Mr. John Shaw, who heretofore has combined the duties of textile expert to the British Thomson-Houston Co., Ltd., with those of manager of their Manchester office, has been appointed mill engineer of the power and mining department of the B. T.-H. Co., Ltd., owing to the rapid development of their textile business, which has necessitated the organisation of a special staff for dealing with same. Mr. Shaw's headquarters will continue to be at the Manchester office of the company, although his duties will extend to the whole of the United Kingdom. Mr. W. J. Cusack, of the head office staff, has been appointed manager of the Manchester office, vice Mr. Shaw. Both appointments date from October 1st.

Mr. James Sayers, of the firm of Sayers & Caldwell, consulting engineers, has been appointed secretary of the Glasgow Local Section of the Institution of Electrical Engineers, in succession to Mr. E. George Tidd.

Mr. M. W. Holmes, chief assistant to Messrs. May & Hawes, consulting engineers, of Caxton House, has been appointed to a vacancy on the editorial staff of *Electrical Engineering*.

**Obituary.** — The death recently occurred of Mr. Grimshaw Holden, who had been engaged at Llanrwst and Trefrew, in North Wales. Deceased was 27 years of age, and he leaves a widow. Mr. Holden served his time at the Accrington Corporation Electricity Works. Subsequently he had an appointment at Newcastle-under-Lyme, which he left to become chief engineer at Llanrwst Electricity Works. His death was due to scalds accidentally received.

## CITY NOTES.

### Willans & Robinson, Ltd.

Mr. Mark Robinson (Chairman) presided at the Cannon Street Hotel on Wednesday, over the 27th half-yearly meeting of the above company.

In moving the adoption of the report (see Electrical Review, October 4th, p. 580), the Chairman said the marked improvement in the final results, as compared with last half-year, was primarily due to the late reduction of capital, which not only permitted of the distribution of profit when made, but, by removing for the present the necessity for further writing-down from the reduced valuation of Queen's Ferry, had added very substantially to the net profit. He would deal first with the more important subject of Rugby, and the new business there which was taking the place of the old business which failed them. It was a subject for much satisfaction that the new business was manifestly promising well. In these early days of recovery one could not say, or expect, more than this. But it was no small thing to be able to say that, for the year—that was for the two half-years—ending last June, the Rugby profits exceeded £41,000. In the memorandum proposing the reduction of capital, the normal Rugby profit, on the present working capital, was assumed to be £40,000 per annum. In their first 12 months of recovery it had been £41,000. It was only for the second half of this period that they were permitted to pay a dividend, and, unluckily, the later of the two half-years, that ending in June, had been (as it nearly always was) less profitable than that which preceded it. Apart from the fact that the six months ending in June were usually less productive than those ending in December, allowance must be made for merely accidental fluctuations resulting from the very short period of their accounts—six months, instead of the 12 months usual with industrial companies. Moreover, the prices of all materials used in engineering had continued very high. He was far from saying, however, that any of these causes fully accounted for the falling off in the half-year's profit at Rugby, which was now £18,275, as against £22,977 in the previous half-year. They could not too clearly recognise that competition in the engineering trade had greatly increased, and continued to cut down prices and profits, with growing harm to the trade and little gain to anyone else. They had avoided the reckless tendering which was unfortunately so common, and therefore it was the more gratifying that they had carried off by far the greater part of the publicly advertised contracts for steam turbines, though their prices were rarely the lowest; they got this preference on the ground of reputation, and he was happy to believe that the preference increased rather than diminished as time went on. The dividend they proposed on the ordinary shares was a small one, viewed in relation to the old nominal value of the shares. But they had never suggested to the shareholders that the restoration of the company's position could be other than a gradual process, and the payment of 10 per cent. on the reduced value, with another 8 per cent. carried forward, was at least a promising beginning. It had to be remembered that in future half-years there would be £1,750 to provide for interest on, and redemption of, the funding certificates issued in settlement of the arrears of preference dividends. To revert to Queen's Ferry, it would be seen that there was a loss of £2,223, against a loss of £12,204 last time. This great reduction was not wholly, though it was mainly, due to the absence of depreciation, for if that item had been wholly omitted in the previous half-year, the loss would still have been £4,592, against the £2,223 which appeared in the present accounts. The improvement was therefore, very real and substantial, and the loss which still remained was less than the amount charged against Queen's Ferry as its contribution to debenture interest and directors' remuneration. In other words, the company was the richer, and not the poorer, by keeping Queen's Ferry at work as compared with closing it, and as, with a view to its ultimate realisation, there would be no question of the advantage of maintaining it as a going concern, he hoped the time had arrived when they might all agree that the policy of keeping the Queen's Ferry works open was one which had passed beyond the stage of present controversy. The further question, whether those works should be developed with a view to real profit-making, was one upon which some of them held strong opinions, and even thought that high expectations were justifiable, but they were all agreed that, since development implied additional outlay, the company could not itself undertake it. A subject of very present interest was the extension of their Rugby trade, and to this end they had paid much attention to the development of foreign business, though it was too early yet to reckon up the results. Mr. Lazenby, who went to Japan last year to examine into the position of their Japanese agency, and to see if it could be made more productive, had been detained there many months by circumstances connected with the agency, which, in the opinion of the board, rendered it desirable that he should remain pending a complete settlement. As regards Japanese orders, the hold of the great American electrical firms over electrical business in Japan was very close and strong, and time after time the order for which Mr. Lazenby had fought had gone past them, even though the engineer of the job had been in their favour. He had, however, secured one order of great importance, because it introduced their turbines into one of the prominent lighting schemes in Japan, and so they hoped might be the forerunner of much future work there. In connection with this question of foreign orders, it would be noticed that in the profit and loss account the item for travelling expenses had much increased, being, roughly, £400 up, as compared with the previous half-year, or £300, as compared with the corresponding half-year of 1906. Of the half-

year's travelling expenses, Japan stood for but little, but a considerable sum had been spent upon endeavours to secure important work on the Continent. As in Japan, those already in possession were too strong to be dispossessed immediately, but their expenditure might bear fruit later. That they were not without value for their money might be inferred from the following figures, which would tell something of the recent growth of the business. Disregarding everything but steam turbines and the accessories immediately connected with them, he would mention that in the first half of this year—that was in the half-year whose accounts they were discussing—the horse-power of the turbines ordered from them was approximately two-thirds of that ordered in the whole of 1906, and the orders in the first three months of the current half-year, fell not greatly short of those for the six months preceding. In nine months of this year they had exceeded by more than 20 per cent. the orders of the twelve months of last year. They were also developing an important business in separate condenser plants, and of these more were ordered from them in the first half of 1907 than in the whole of 1906. The benefit of these orders did not, of course, enter into their present accounts, nor could it help them for some time to come; but it would show that their increased expenditure upon the getting of orders had not been in vain, and it gave ground for believing that even with the present low prices they would continue to improve their position in the future. The Chairman concluded by referring to the simplification of the accounts, which had been carried out on the advice of the auditors.

Mr. Beckford seconded the motion.

Mr. G. Brown, while glad to see the results, expressed some misgiving as to the way in which the surplus had been dealt with. He felt it would have been better had they retained the whole of the profits.

Col. Plunkett asked if the board would not consider the question of reducing the number of directors to what it was when the company were in a flourishing state. He considered three directors ample.

Mr. Willard, as a critic on former occasions, was glad to congratulate the board; while he realised the necessity of caution, still, they could have too much caution. It seemed to him that Mr. Brown rather endorsed the preference shareholders' point of view.

Sir Gilbert A. Clayton East (deputy chairman) said if the board were reduced to three, he would not remain. It simply meant that two men did the work, and the third had no voice whatever.

The Chairman said that the board had no choice in the matter with regard to dividend. If they had a balance they were bound to pay the preference dividend. In the cutting down of capital the preference shareholders were favourably treated, and it was only right that the ordinary shareholders should be considered. As to the large amount of debtor balance outstanding, that was due to the circumstances of their business. Since the date of the accounts there had been £98,000 paid. The board had not considered the question of the reduction of directors, but their most prosperous days were when they had five directors. He did not think a reduction would be a good thing.

The report was adopted with four dissentients, and a resolution for the payment of 6 per cent. on the preference shares, and 10 per cent. on the ordinary shares, was agreed to.

## Edison & Swan United Electric Light Co., Ltd.

In their report for the year ending June 30th, 1907, the directors state that the net revenue account shows that the sum of £54,237 has been brought forward from profit and loss account. Interest on debenture stocks has absorbed £16,390; £11,000 has been set aside as depreciation on freehold and leasehold property, plant, machinery and tools; £1,477 has been applied in writing down values of stocks; and the sum of £1,355 has been reserved on account of bad and doubtful debts; £7,500 has been added to the reserve fund. The result as shown in the net revenue account is a credit balance of £16,515, to which must be added the sum of £9,007 brought forward from the previous year, thus making a total of £25,522, out of which the directors recommend the payment of a dividend for the year on the "A" shares at the rate of four and one-sixth per cent. (being 4s. 2d. per fully paid "A" share, and 2s. 6d. per part-paid "A" share), amounting to £15,978, leaving a sum of £9,543 to be carried forward. During the year £6,100 of this company's debenture stocks have been purchased and cancelled, resulting in a profit of £582 in addition to that shown above. This amount has been appropriated as a reserve against stock depreciation. Cost of establishing the business, goodwill, &c., £390,432, has been brought forward at the figure standing in the last balance-sheet. The freehold and leasehold property, plant and machinery have also been brought forward at the value stated in the last balance-sheet, with the addition of the amount expended to June 30th, 1907, less depreciation charged in net revenue account. There has been expended on capital during the year ending June 30th, 1907, £7,658. The shares of the Altrincham Electric Supply, Ltd., have been taken at par, as in previous years. This concern continues to show satisfactory progress, and has paid a dividend at the rate of 5 per cent. on its shares for the year ended December 31st, 1906. Its indebtedness to this company has been reduced during the year by £341. Mr. H. Wolfenden, jun., has been elected a director of the company.

**Mexico Tramways Co.**—The directors announce the payment of a first dividend at the rate of 4 per cent. per annum. Improvements and extensions are proceeding.

## Dundee, Broughty Ferry and District Tramways Co., Ltd.

The directors' report for the year ended July 31st, 1907, as submitted to the meeting held on Monday at Dundee, shows a profit (including sum brought forward) of £3,461, from which there falls to be deducted:—Interim dividend on 6 per cent. preference shares paid February 1st, 1907, £1,500; leaving a balance of £1,961. The directors recommend a final dividend on 6 per cent. preference shares (£1,500), carrying forward, subject to remuneration of managing director, £461. Before arriving at the above figures there has been set aside by the directors of the statutory company the sum of £1,300 against depreciation. The year closing at July 31st, 1907, has been pronounced by tramway experts as being among the worst ever experienced, and the long continued unfavourable weather had a very material effect in preventing greater expansion of the company's business—the line, owing to its suburban character, being naturally more susceptible to weather conditions than a town line. It is, however, very gratifying, and, in the opinion of the directors, the very best evidence of the value of the undertaking, that the earnings for the year now closed reached the sum of £12,351. A steady traffic has been built up, and given only normal weather the takings of the company can be considerably increased.

**Anglo-American Telegraph Co., Ltd.**—The directors have resolved to declare an interim dividend for the quarter ending September 30th, 1907, of 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock, less income-tax, payable on November 1st.

**Companies Struck off the Register.**—The following companies have been struck off the register:—

Britannia Electric Carriage Syndicate, Ltd.
Britelite Co., Ltd.
Effective Smoke Preventer and Fuel Economiser Co., Ltd.
Electric Heating Corporation, Ltd.
Manufacturing Electric Co., Ltd.
Miniature Arc Lamps, Ltd.
Perfect Dry Seat Syndicate, Ltd.
Suspended Electric Railway Co., Ltd.
Zea Arc Lamp Co., Ltd.

**Prospectuses.**—*The Takapuna Tramways and Ferry Co., Ltd.*—A prospectus has been before the investing public in New Zealand recently inviting applications for 75,000 shares of £1 each. An electric tramway is to be equipped between O'Neill's Point and Lake Takapuna, and a ferry service established between O'Neill's Point and the city of Auckland. One of the directors of the new company (Mr. P. M. Hansen) is also on the board of the Auckland Electric Tramways Co., Ltd.

*The Posoltega Rubber Estates, Ltd.*—This company has been offering 18,500 £1 shares for subscription. It is to acquire the Chiquimulapa Rubber Plantation on the West Coast of Nicaragua, which has 90,000 rubber trees.

*Java Rubber Plantations, Ltd.*—This company has been offering 19,500 £1 shares for subscription.

**Platinum Corporation, Ltd.**—At the statutory meeting held in London last week, Sir Ernest Clarke, who presided, said that the platinum industry was one of increasing importance and interest, and, therefore, it was considered that there would be advantages in the establishment in this country of an organisation similar to that in Paris for dealing generally in platinum. A mining engineer had been selected to go over the properties and advise the directors as to the best and most promising directions in which to commence operations. This gentleman journeyed to St., Petersburg, where the purchase of the properties was completed, and he was now in the Urals engaged in a thorough inspection of the concessions.

**Stock Exchange Notices.**—The Committee have appointed special settling days as under:—

Wednesday, October 16th.—Matale Ceylon Rubber Co., Ltd.—15,000 shares of £1 each, fully paid, Nos. 15,001 to 30,000.

Platinum Corporation, Ltd.—59,255 ordinary shares of £1 each, 10s. paid, Nos. 1 to 59,255, and 36,244 deferred shares of 1s. each, fully paid, Nos. 1 to 36,244.

Sungei Salak Rubber Co., Ltd.—41,000 shares of £1 each, 10s. paid, Nos. 14,001 to 55,000.

Willans & Robinson, Ltd.—Funding certificates for £34,999 13s.

And ordered the undermentioned securities to be quoted in the Official List:—

American Telephone and Telegraph Co.—$131,551,400 capital stock in shares of $100 each.

**Eastern Extension, Australasia and China Telegraph Co., Ltd.**—The directors have declared an interim dividend for the quarter ended June 30th last of 2s. 6d. per share.

**Direct United States Cable Co., Ltd.**—An interim dividend of 4s. per share, free of income-tax (at the rate of 4 per cent. per annum), is announced for the quarter ending September 30th, and is payable on and after 26th inst.

## ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

| Locality. | Fortnight ended. | Receipts for the fortnight. | | No. of wks. | Total to date. | | Route miles open. | |
|---|---|---|---|---|---|---|---|---|
| | | £ | £* | | £ | £* | | Inc. |
| Aberdeen | Oct. 2 | 2,990 | —1,220 | 18 | 28,003 | — 1,666 | 14·4 | .. |
| Ayr | ,, 5 | 635 | + 44 | 21 | 8,470 | — 198 | 8 | .. |
| Bath | ,, 2 | 1,774 | — 96 | 40 | 32,486 | — 1,383 | 18 | .. |
| Belfast | ,, 4 | 7,338 | + 666 | 27 | 100,618 | + 6,722 | 36 | .. |
| Birkenhead | ,, 6 | 2,246 | — 22 | 26 | 29,140 | — 433 | 13·52 | .. |
| Birmingham Corp. | ,, 5 | 12,981 | .. | 27 | 164,474 | .. | 56·46 | .. |
| †Blackburn | Sept. 25 | 1,313 | + 146 | 26½ | 30,237 | + 1,760 | 14·13 | .. |
| Blackpool Corp. | Oct. 3 | 3,881 | + 350 | .. | 42,252 | — 1,685 | 11·87 | .. |
| ,, —Fleetw'd. | ,, 5 | 1,911 | + 45 | 13 | 19,949 | — 1,154 | 8·25 | .. |
| Bolton | ,, 6 | 4,605 | + 313 | 27 | 63,070 | + 9,683 | 26 | .. |
| Bournemouth | ,, 2 | 3,633 | + 116 | 26½ | 50,834 | + 979 | 21·5 | 2½ |
| Bradford | ,, 5 | 9,749 | + 548 | 27 | 128,554 | + 1,614 | 53 | .. |
| Brighton | ,, 6 | 1,953 | — 63 | 27 | 27,404 | — 2,747 | 9·5 | .. |
| Bristol | ,, 4 | 10,520 | + 41 | .. | .. | .. | 28·5 | .. |
| Brit. Elec. Trac. Co. | | | | | | | | |
| Airdrie | Sept. 27 | 464 | — 9 | 38 | 8,534 | — 63 | 3·65 | .. |
| Barnsley | ,, 27 | 338 | + 11 | ,, | 6,443 | + 74 | .. | .. |
| Barrow | ,, 27 | 568 | + 3 | ,, | 10,067 | — 170 | 5·87 | .. |
| Cavehill | ,, 27 | 210 | — 38 | ,, | 3,337 | — 148 | .. | .. |
| Devonport | ,, 27 | 1,002 | — 26 | ,, | 17,851 | — 154 | 8·85 | .. |
| Gateshead | ,, 27 | 2,045 | + 35 | ,, | 38,600 | + 909 | 11·25 | .. |
| Gravesend | ,, 27 | 546 | + 30 | ,, | 9,588 | — 54 | 6·5 | .. |
| Greenock | ,, 27 | 1,360 | — 225 | ,, | 25,656 | — 1,000 | 7·25 | .. |
| Hartlepool | ,, 27 | 641 | + 29 | ,, | 11,356 | — 628 | 6·72 | .. |
| Kidderminster | ,, 27 | 278 | + 48 | ,, | 4,777 | — 147 | .. | .. |
| Leamington | ,, 27 | 418 | + 54 | ,, | 6,395 | — 698 | 8 | .. |
| Merthyr | ,, 27 | 448 | + 31 | ,, | 8,085 | + 415 | 2·9 | .. |
| Metropolitan | ,, 27 | 11,030 | +4,025 | ,, | 179,699 | +45,133 | 22 | .. |
| Middleton | ,, 27 | 778 | + 59 | ,, | 13,837 | — 141 | 8·5 | .. |
| Mid. Joint Com'tee | ,, 27 | 12,230 | + 149 | ,, | 223,448 | + 2,315 | .. | .. |
| Oldham — Ashton | ,, 27 | 1,292 | + 113 | ,, | 23,380 | + 1,108 | 9·13 | .. |
| Peterborough | ,, 27 | 284 | + 29 | ,, | 4,944 | — 240 | 5·81 | .. |
| Potteries | ,, 27 | 3,955 | + 226 | ,, | 71,854 | + 2,185 | 29 | .. |
| Rothesay | ,, 27 | 506 | — 160 | ,, | 9,624 | — 726 | 2·75 | .. |
| Southport | ,, 27 | 698 | + 9 | ,, | 12,079 | — 619 | 8·17 | .. |
| S. Metropolitan | ,, 27 | 1,969 | .. | ,, | 31,885 | .. | .. | .. |
| Swansea | ,, 27 | 2,062 | + 291 | ,, | 35,491 | + 2,408 | 5·5 | .. |
| Tynemouth | ,, 27 | 580 | + 86 | ,, | 9,999 | — 781 | 3·75 | .. |
| Weston-s-Mare | ,, 25 | 558 | + 128 | ,, | 6,464 | — 451 | 8 | .. |
| ‡Worcester | ,, 27 | 688 | + 58 | ,, | 11,121 | — 219 | 5·75 | .. |
| Wrexham | ,, 27 | 224 | — 3 | ,, | 3,991 | — 66 | .. | .. |
| Yorks. Wool. Dist. | ,, 27 | 1 821 | — 104 | ,, | 36,349 | + 914 | 17 | .. |
| Miscellaneous | ,, 27 | 470 | + 5 | ,, | 8,701 | — 179 | .. | .. |
| Burnley | Oct. 5 | 2,631 | + 45 | .. | .. | .. | 7·5 | .. |
| Burton-on-Trent | ,, 6 | 608 | — 22 | 27 | 8,105 | — 898 | 11 | 2 |
| Bury | Sept. 29 | 2,482 | .. | 26 | 29,800 | .. | 10·5 | .. |
| †Cardiff | Oct. 5 | 2 078 | — 94 | 27 | 60 395 | + 1,602 | 15·87 | .. |
| Carlisle | ,, 5 | 377 | — 11 | 40 | 7,018 | — 536 | .. | .. |
| Chatham and Dist. | ,, 3 | 1,590 | — 166 | 40 | 29,205 | + 1,549 | 19·16 | ·68 |
| †Cork | ,, 3 | 1,079 | + 16 | 40 | 18,909 | — 727 | 9·89 | .. |
| Croydon | ,, 4 | 3,028 | + 47 | 27 | 39,885 | — 1,844 | 12 | ·75 |
| Darlington | ,, 5 | 419 | — 6 | 27 | 5,814 | — 70 | .. | .. |
| Darwen | ,, 4 | 534 | + 1 | 27 | 7,040 | — 15 | 4·66 | .. |
| Dover | ,, 5 | 512 | — 13 | 27 | 6 861 | — 934 | 4·75 | .. |
| Dublin | ,, 4 | 18,832 | +3,675 | .. | 103,199 | +24,380 | 54·25 | 6·5 |
| Dundee | ,, 2 | 2,331 | — 5 | 20 | 23.308 | + 484 | 13 | ·5 |
| East Ham | ,, 5 | 1,910 | + 77 | 27 | 25,379 | — 268 | 8 | .. |
| Exeter | ,, 4 | 653 | — 52 | 27 | 9,187 | — 686 | 4·75 | ·5 |
| Glasgow | ,, 5 | 37,998 | +1,254 | .. | 320,997 | + 6,373 | 89·75 | 8 |
| Hastings | ,, 3 | 2.576 | .. | .. | .. | .. | .. | .. |
| Huddersfield | ,, 5 | 3,618 | + 51 | 27 | 44,196 | + 1,986 | 28 | .. |
| Hull | ,, 5 | 4,858 | + 246 | 26 | 64,990 | + 3,308 | 13 | .. |
| Ilkeston | ,, 2 | 301 | + 17 | 27 | 3,988 | + 211 | 3·5 | .. |
| Ipswich | ,, 5 | 867 | — 13 | 27 | 11,963 | — 911 | 10·5 | .. |
| Isle of Thanet | Sept. 21 | 2,370 | + 241 | 38 | 27,201 | — 657 | 11 | .. |
| Kilmarnock | Oct. 5 | 321 | — 15 | 20 | 3,380 | — 92 | 4·25 | .. |
| Lan'kshire Trm. Co. | ,, 3 | 2 826 | + 842 | 40 | 47,488 | +12,123 | 15·82 | 9·26 |
| Lancashire United | ,, 2 | 2,720 | + 363 | 40 | 51.026 | +12,687 | 39 | 1 |
| Leeds | ,, 5 | 13,495 | + 756 | 27 | 179,958 | + 7,445 | 51·13 | .. |
| Leicester | ,, 5 | 4,449 | — 23 | .. | .. | .. | .. | .. |
| Leith | Sept. 28 | 1,019 | — 52 | 19½ | 10,754 | — 76 | 6 | .. |
| Liverpool | ,, 28 | 22,560 | + 515 | 39 | 426,868 | + 7,488 | 104 | .. |
| ‡L.C.C. | ,, 28 | 65,323 | +14,680 | 26 | 919,096 | +134,738 | 116½ | 22·63 |
| London United | Oct. 4 | 14,331 | +1,659 | .. | 265,008 | +11,515 | .. | .. |
| †Lowestoft | ,, 5 | 227 | + 4 | .. | .. | .. | 3·5 | .. |
| Manchester | ,, 5 | 31,718 | +2,315 | 27 | 406,785 | +30,469 | 86 | 11 |
| Newcastle | ,, 5 | 8,105 | — 51 | 27 | 111,462 | + 308 | .. | .. |
| Newport | ,, 5 | 1,847 | + 49 | 27 | 19,458 | + 1,655 | 14·5 | .. |
| Northampton | ,, 4 | 905 | — 33 | 26½ | 12,184 | — 556 | 5·5 | .. |
| Oldham | ,, 6 | 3 994 | + 175 | 28 | 55,168 | + 3,393 | 23·75 | .. |
| Pontypridd | ,, 5 | 557 | + 215 | 27 | 7,936 | + 2,602 | 5 | 1·75 |
| Portsmouth | ,, 5 | 4,183 | + 147 | 27 | 61,048 | — 2,060 | 14·5 | .. |
| Preston | ,, 2 | 1,524 | + 22 | .. | .. | .. | .. | .. |
| Reading | ,, 3 | 1,296 | — 9 | 26½ | 17,101 | — 707 | 13·25 | .. |
| Rotherham | ,, 3 | 1,287 | + 247 | 26½ | 16,804 | + 2,890 | 10 | ·66 |
| Salford | ,, 7 | 9,593 | + 370 | 27 | 129,013 | + 3 480 | 38·9 | .. |
| Sheffield | ,, 6 | 11,458 | + 615 | 28 | 156,669 | + 6,983 | 35·75 | .. |
| Southampton | ,, 2 | 2,240 | + 220 | 26½ | 28,372 | + 1,944 | .. | .. |
| Southend-on-Sea | ,, 2 | 955 | + 124 | 27 | 12,787 | — 171 | .. | .. |
| Sunderland | ,, 6 | 2,624 | — 126 | 27 | 39,342 | — 550 | .. | .. |
| Swindon | ,, 2 | 369 | + 10 | .. | .. | .. | 4·4 | .. |
| Tyneside | ,, 2 | 911 | — 9 | 40 | 18.642 | + 797 | 8·27 | .. |
| Wallasey | ,, 5 | 1,716 | + 51 | 27 | 24,078 | + 865 | 8·72 | ·22 |
| Walthamstow | ,, 5 | 1,829 | + 159 | 27 | 17,894 | + 176 | 9 | .. |
| West Ham | ,, 3 | 4,720 | + 62 | 27 | 64,239 | + 1,403 | 14·7 | .. |
| Wolverhampton | ,, 2 | 1,752 | + 37 | 26 | 23,320 | + 318 | 12·5 | .. |
| Yorks. W. Riding | ,, 6 | 2,560 | + 859 | 40 | 46.691 | .. | .. | .. |
| Baker St.-Waterloo | ,, 5 | 4,825 | +1,600 | 14 | 31,960 | +12,495 | 4·25 | 1 |
| Cen. London Rly. | ,, 5 | 10,302 | —2,229 | 14 | 67,881 | —10,597 | 6 | .. |
| Char. +, Eus. Hamp | ,, 5 | 5,190 | .. | 14 | 35,195 | .. | 7·75 | .. |
| City & S. Lon. Rly. | ,, 6 | 6 070 | + 469 | 14 | 42.360 | + 7,076 | 6 3 | 1·05 |
| Dublin-Lucan Rly. | ,, 4 | 292 | + 98 | 14 | 2,184 | + 179 | 7 | .. |
| G.N. and City Rly. | ,, 5 | 3,355 | — 207 | 14 | 24,343 | — 804 | 3·5 | .. |
| G.N., P'dy. & Brmp. | ,, 5 | 8,420 | + 260 | 14 | 54,745 | .. | 9 | .. |
| L'pool Overh'd Rly. | ,, 6 | 8,020 | + 180 | 14 | 22,933 | + 1,361 | 6·8 | 4·3 |
| Mersey Railway | ,, 5 | 3 843 | + 259 | 14 | 25 529 | + 1,868 | 4 5 | .. |
| Metropolitan Rly. | ,, 6 | 30,505 | + 495 | 14 | 206,398 | + 5,276 | 24·5 | .. |
| Met. District Rly. | ,, 6 | 15,675 | — 502 | 14 | 102,489 | — 918 | 24 | .. |
| Anglo-Argentine | ,, 7 | 35,695 | +3,625 | 40 | 681,144 | +64,638 | 48 | .. |
| §Auckland | Sept. 13 | 9,905 | + 195 | 26 | 93,674 | + 3,668 | 19·2 | ·56 |
| §Brisbane | Sept. | 12,660 | +1,081 | .. | .. | .. | .. | .. |
| §Brit. Columbia Rly. | August | 31,400 | +8,800 | 9 | 62,600 | +18,250 | .. | .. |
| Calcutta | Oct. 5 | 6,714 | + 956 | .. | .. | .. | .. | .. |
| §Cape Electric T. Ld. | August | 9,240 | .. | .. | .. | .. | .. | .. |
| §Geneva | ,, | 9 579 | + 627 | .. | .. | .. | .. | .. |
| §Kalgoorlie, W.A. | ,, | 4,549 | .. | 35 | 31,955 | .. | 20·5 | .. |
| Madras | Sept. 30 | 1,106 | + 235 | 39 | 20,697 | + 3,659 | 12·75 | 2·25 |
| §Lisbon | May | 896 | .. | .. | .. | .. | .. | .. |
| Perth (W.A.) | Oct. 4 | 2,587 | — 198 | 40 | 55,986 | — 1,995 | 25·6 | ·4 |

* Compared with the corresponding period of 1906. † One week only.
‡ Includes horse, steam and other receipts. § One month.

## STOCKS AND SHARES.

Tuesday Evening.

Consols have led the way, as the feature of the week, with pronounced strength. Buying orders for stock, in amounts which ran into six figures, caused a sudden change to come over prices and gave an impetus to investment markets all round. The speculative departments, however, were in a case by no means so good. Copper, the metal, continues to be the most disturbing feature of the mining, American Railroad, and their subsidiary markets. And copper, despite its already severe fall, is talked still lower by self-constituted authorities in the Stock Exchange, though their tone is not so confident as it was a few weeks back.

Rubber shares are receiving a good deal of attention, and the only new companies that seem to find any favour with the public are those devoted to this industry. Rubber companies, on the whole, are quite moderately capitalised, and the prospectuses lately published have mostly been reasonable propositions, the wild cat having hitherto shown a usefully modest shyness. The rubber market, however, has already had its ups and downs, and the fear of the moment is concerned less with the prospects of production than with the possibility of rubber being superseded by a substitute.

While the Marconi bogey looms less largely in the eyes of the holder of cable telegraph stocks, the fall has simply been stayed; no rally has yet occurred. The nervousness is wearing off, and our own knowledge reaches to the cancellation of several selling orders that had been left with brokers to execute when part of the slump had been recovered. To those who are really interested in the subject, a study of a leading article in last Saturday's *Economist* may be of use. The case is put clearly, and the writer strives hard to be impartial, the while he declines to believe the present cable companies are in any danger of being driven out of the seas.

Anglo-Americans are fairly firm, the Ordinary stock shedding a point. The Preferred, though unaltered nominally, can now be realised without difficulty, which is more than can be said of the situation a week ago. The 4 per cent. Debenture stocks of both the Eastern Telegraph and the Eastern Extension Companies have receded to 101½, a fall of two or three points, which brings the securities more into line with a good many other excellent stocks of somewhat similar character. In the case of the Eastern, the half-yearly 2 per cent. interest is payable at the end of the present month, so that the buyer gets the full 4 per cent. return on his money, with a security which is unimpeachable.

The Trust companies' issues have not altered except for a small decline in Globe Preference, nor has there been any change in Telephone varieties. All round the Stock Exchange the last few weeks have witnessed steady liquidation of sound stocks to pay losses made over speculations, and from this influence the Telegraph section has not been free. Marconi shares slipped back to 17s. 6d., although a storm on Tuesday at the New York end of the cables caused temporary delay to the submarine service. Fluctuations in the Electricity Supply list have been of the mildest sort. Charing Cross Preference hardened to 3⅞, though the "City Undertaking" shares kept at 3⅝. South Metropolitan Preference recovered their slight weakness, and the Debenture stock picked up a point. South Metropolitan Preference rose to 1½. Otherwise the catalogue is cruelly colourless.

Firmness in Home Railway stocks followed naturally upon the strength of Consols, but it cannot be said that electrical descriptions have derived much benefit from this. Metropolitan Consolidated, in fact, was distinctly flat, shedding 2 to 36½. Nevertheless, Districts were firm at 11½. City and South London Ordinary rose to 47, then receded to 46, and Great Northern and City Preferred lost their previous 5s. rise. This took the price back to 30s.

Traction issues are mostly dull. There is the usual drop in British Electric Tractions: the Ordinary have got down to 2, the Preference to 5⅞, and, perhaps, it would not be difficult to buy at either quotation. Calcutta Trams drooped again, partly because of the new shares, and German holders have been realising Anglo-Argentine Tramway shares. For this last, the depression in certain other markets is regarded as the primary reason.

Vague talk of good business in iron, coal and steel trades, brought about a slight decline in Babcock & Wilcox Ordinary to 3⅞. Willans & Robinson Debenture eased off upon further consideration of the report. Telegraph Constructions were lowered, and the manufacturing section has no advance to exhibit. Electric Construction Preference were flat at 15s. Armament shares gave way a trifle, Vickers & Armstrong both being slightly lower.

**Primitiva Gas and Electric Lighting Co. of Buenos Ayres, Ltd.**—The directors have declared an interim dividend of 2s. 6d. each on the ordinary shares.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. * | Dividends for the last four years. 1903. | 1904. | 1905. | 1906. | Closing Quotations Oct. 1st. | Closing Quotations Oct. 8th. | Business done week ended Oct. 8th, 1907. Highest | Lowest. | Rise + or Fall — | Present Yield per cent £ s. d. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | Nil | Nil | Nil | .. | 3 — 3½ | 3 — 3½ | .. | .. | .. | Nil |
| 149,600 | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | Nil | Nil | 5 % | 5 % | 85 — 88 | 85 — 88 | .. | .. | .. | 5 13 8 |
| 660,660 | Anglo-American Telegraph .. .. .. .. | Stock | 6½. | 2¾% | 3½% | 3¾% | 55 — 58 | 54 — 57 | 54 | .. | —1 | 7 8 0 |
| 3,169,670 | Do. do. do. 6 % Pref. .. .. | Stock | 6 % | 5⅝% | 6 % | 6 % | 97 —100 | 97—100 | 98½ | 97½ | .. | 6 0 0 |
| 3,169,670 | Do. do. do. Deferred .. .. | Stock | 2s. | Nil | 3/8 | 12½% | 15⅛ — 16 | 15⅛ — 16 | 16⅛ | 15⅛ | .. | 10 18 9 |
| 50,000 | Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red. | 100 | .. | .. | 5 % | 5 % | 99 —102 xd | 99 —102 | .. | .. | .. | 4 18 0 |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 .. .. .. | 5 | 7 % | 8 % | 8 % | 8 % | 6⅞— 7⅛ | 6⅞— 7⅛ | .. | .. | .. | 5 10 4 |
| 2,097,680 | Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red. | Stock | 4 % | 4 % | 4 % | 4 % | 90 — 92 xd | 90 — 92 | 90¼ | .. | .. | 4 7 0 |
| 16,000 | Cuba Telegraph .. .. .. .. .. | 10 | 0 % | 5 % | 5 % | 5 % | 6¼ — 7⅛ | 6¼ — 7⅛ | 7 | .. | .. | 6 13 4 |
| 6,000 | Do. 10 % Pref. .. .. .. .. | 10 | 15 % | 10 % | 10 % | 10 % | 15½— 16½ | 15½— 16½ | .. | .. | .. | 5 19 5 |
| 12,981 | Direct Spanish Telegraph, Ord. .. .. .. | 5 | 4 % | 4 % | 4 % | 4 % | 3¼— 3½ xd | 3¼— 3½ | .. | .. | .. | 5 14 3 |
| 6,000 | Do. do. 10 % Cum. Pref. .. | 5 | 10 % | 10 % | 10 % | 10 % | 9 — 9½ | 9 — 9½ | .. | .. | .. | 5 5 3 |
| 30,000 | Do. do. 4½ % Debs. .. .. | 50 | 4½% | 4½% | 4½% | 4½% | 98 —101 | 98 —101 | .. | .. | .. | 8 18 2 |
| 60,710 | Direct United States Cable .. .. .. | 20 | 3 % | 3½% | 4½% | 4½% | 12¼— 13½ | 12½— 13½ | 12⅞ | 12½ | .. | 7 3 0 |
| 57,000 | Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R. | 100 | 4½% | 4½% | 4½% | 4½% | 100 —102 | 100 —102 | .. | .. | .. | 4 8 3 |
| 4,000,000 | Eastern Telegraph, Ord. Stock .. .. .. | Stock | 7 % | 7 % | 7 % | 7 % | 130 —135 | 130 —135 | 131½ | 130 | .. | 5 3 8 |
| 2,000,000 | Do. 3½ % Pref. Stock .. .. .. | 100 | 3½% | 3½% | 3½% | 3½% | 85 — 88 | 85 — 88 | .. | .. | .. | 3 19 7 |
| 1,896,706 | Do. 4 % Mort. Deb. Stock. Red. .. | Stock | 4 % | 4 % | 4 % | 4 % | 103 —105 | 100 —103 | 102½ | 102 | —2½ | 3 17 8 |
| 300,000 | Eastern Extension, Australasia, and China Tele. | 10 | 7 % | 7 % | 7 % | 7 % | 11⅞— 12⅞ | 11⅞— 12⅞ | 12¼ | 11⅞ | .. | 6 18 10 |
| 752,400 | Do. 4 % Deb. Stock .. .. .. | Stock | 4 % | 4 % | 4 % | 4 % | 102 —104 | 100 —103 | 100 | .. | —1½ | 3 17 8 |
| 295,400 | East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909 | 100 | 4 % | 4 % | 4 % | 4 % | 97½—100½ | 97½—100½ | .. | .. | .. | 3 19 7 |
| 200,000£ | Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | 4 % | 4 % | 4 % | 4 % | 100 —102 | 100 —102 | .. | .. | .. | 3 18 5 |
| 181,127 | Globe Telegraph and Trust .. .. .. | 10 | 5½% | 5⅝% | 5½% | 5⅝% | 9⅜— 10½ xd | 9½— 10⅝ | 10⅛ | 9⅝ | + ⅛ | 5 4 9 |
| 181,127 | Do. do. 6 % Pref... .. .. | 10 | 6 % | 6 % | 6 % | 6 % | 13 — 13½ xd | 12⅝— 13⅛ | 13 7/16 | 12 13/16 | — ⅛ | 4 8 11 |
| 150,000 | Great Northern Telegraph, of Copenhagen.. .. | 10 | 15 % | 24 % | 24% | 20 % | 34 — 36 | 34 — 36 | .. | .. | .. | 5 11 1 |
| 28,900 | Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | 4½% | 4½% | 4½% | 4½% | 100 —102 | 100 —102 | .. | .. | .. | 4 8 3 |
| 17,000 | Indo-European Telegraph .. .. .. .. | 25 | 10 % | 13 % | 13 % | 13 % | 55 — 57 | 55 — 57 | .. | .. | .. | 5 14 0 |
| $41,380,400 | Mackay Companies Common .. .. .. | $100 | .. | 1 % | 2 % | 3½% | 64 — 67 | 64 — 67 | .. | .. | .. | 5 4 6 |
| $50,000,000 | Do. do. 4% Cum. Pref. .. .. .. | $100 | .. | 4 % | 4 % | 4 % | 64 — 67 | 64 — 67 | .. | .. | .. | 5 19 5 |
| 256,127 | Marconi's Wireless Telegraph .. .. .. | 1 | Nil | Nil | Nil | .. | 1/16 — 1⅛ | 3/16 — 1 | 19/6 | 18/9 | —1/16 | Nil |
| 72,680 | Monte Video Telephone Co., Ltd. Ord. .. .. | 1 | 3 % | 4 % | 5 % | .. | 1⅛ — 1 3/16 | 1⅛ — 1 3/16 | 20/- | .. | .. | 4 14 1 |
| 86,492 | Do. do. do. 5 % Pref. .. .. | 1 | 5 % | 5 % | 5 % | .. | 1 — 1 | 1 — 1 | .. | .. | .. | 5 0 0 |
| 2,225,000 | National Telephone, Pref. Stock .. .. .. | 100 | 6 % | 6 % | 6 % | 6 % | 106 —108 | 106 —108 | 107¼ | 106 | .. | 5 11 1 |
| 2,225,000 | Do. do. Def. Stock .. .. .. | 100 | 5 % | 5 % | 5 % | 5 % | 106 —108 | 106 —108 | 107½ | 106 | .. | 4 12 7 |
| 15,000 | Do. do. 6 % Cum. 1st. Pref. .. .. | 10 | 6 % | 6 % | 6 % | 6 % | 10⅛— 12⅛ | 10⅛— 12⅛ | 12 | .. | .. | 4 16 0 |
| 15,000 | Do. do. 6 % Cum. 2nd Pref. .. .. | 10 | 6 % | 6 % | 6 % | 5 % | 10 — 12 | 10 — 12 | .. | .. | .. | 4 3 4 |
| 250,000 | Do. do. 5 % Non-cum. 3rd P., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 5 % | 5⅛ — 5⅜ | 5⅛ — 5⅜ | 5 13/16 | 5 7/16 | .. | 4 10 11 |
| 2,000,000 | Do. do. 3½ % Deb. Stock Red. .. | Stock | 3½% | 3½% | 3½% | 3½% | 96 — 98 | 96 — 98 | 97½ | 96½ | .. | 3 1 3 |
| 1,689,593 | Do. do. 4 % Deb. Stock Red. .. .. | 100 | 4 % | 4 % | 4 % | 4 % | 101 —103 | 101 —103 | 101½ | .. | .. | 3 18 1 |
| 179,313 | Oriental Telep. and Elec. 1 to 171,504, fully paid .. | 1 | 6½% | 6½% | 7 % | 7 % | 1⅛ — 1⅜ | 1⅛ — 1⅜ | .. | .. | .. | 5 1 10 |
| 50,000 | Do. do. do. 6 % Cum. Pref... .. | 1 | 6 % | 6 % | 6 % | 6 % | 1 5/16 — 1 7/16 | 1 5/16 — 1 7/16 | .. | .. | .. | 4 11 5 |
| 100,000 | Do. do. do. . 4 % Red. Deb. Stock .. | 100 | .. | .. | 4 % | 4 % | 91 — 94 | 91 — 94 | 91½ | .. | .. | 4 5 1 |
| 100,000 | Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000 | 10 | 4 % | 4 % | 4 % | 4 % | 97 —100 | 97 —100 | .. | .. | .. | 4 0 0 |
| 11,889 | Reuter's .. .. .. .. .. .. | 8 | 5 % | 5 % | 5 % | 5 % | 7 — 8 | 7 — 8 | .. | .. | .. | 5 0 0 |
| 60,000 | Telephone Co. of Egypt, 4½ % Deb. Red. .. .. | 100 | .. | .. | 4½% | 4½% | 98 —101 | 98 —101 | .. | .. | .. | 4 9 1 |
| 3,167 | Submarine Cables Trust .. .. .. .. | Cert. | 6 % | 6 % | 6 % | 6 % | 127 —130 | 127 —130 | .. | .. | .. | 4 12 4 |
| 80,000 | United River Plate Telephone .. .. .. | 5 | 8 % | 8 % | 8 % | 8 % | 6⅞— 7⅛ | 6⅞— 7⅛ | .. | .. | .. | 5 10 4 |
| 40,000 | Do. 5 % Cum. Pref., Nos. 1 to 40,000 | 5 | 5 % | 5 % | 5 % | 5 % | 5 — 5⅛ | 5 — 5⅛ | .. | .. | .. | 4 10 11 |
| 15,609 | West African Telegraph, Shares .. .. .. | 10 | 4 % | 4½% | 4 % | 4 % | 10 — 10½ | 10 — 10½ | .. | .. | .. | 3 16 3 |
| 30,008 | W. Coast of America, 1 to 30,000 & 53,001 to 53,008 | 2 | Nil | Nil | Nil | 2½% | 1⅛ — 1⅜ | 1⅛ — 1⅜ | .. | .. | .. | 3 12 9 |
| 150,000 | Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel. | 100 | 4 % | 4 % | 4 % | 4 % | 97 —100 | 97 —100 | .. | .. | .. | 4 0 0 |
| 207,930 | Western Telegraph, Ltd., Nos. 1 to 207,930.. .. | 10 | 7 % | 7 % | 7 % | .. | 12½— 13½ | 12½— 13½ | 12⅝ | 12½ | .. | 5 3 8 |
| 800,000 | Do. do. 4 % Deb. Stock Red. .. | 100 | 4 % | 4 % | 4 % | 4 % | 100 —103 | 100 —103 | .. | .. | .. | 3 17 8 |
| 88,321 | West India and Panama Telegraph .. .. .. | 10 | Nil | Nil | Nil | Nil | 7/16 — 9/16 | 7/16 — 9/16 | .. | .. | .. | Nil |
| 34,563 | Do. do. 6 % Cum. 1st Pref. .. .. | 10 | 7 %† | 6 % | 5 % | 8 % | 7⅛ — 7⅝ | 7⅛ — 7⅝ | .. | .. | .. | 10 5 9 |
| 4,669 | Do. do. 6 % Cum. 2nd Pref. .. .. | 10 | Nil | Nil | Nil | Nil | 6¼ — 7⅛ | 6¼ — 7⅛ | .. | .. | .. | Nil |
| 80,000£ | Do. do. 5 % Debs., Nos. 1 to 1,800 .. | 100 | 5 % | 5 % | 5 % | 5 % | 99 —102 | 99 —102 | .. | .. | .. | 4 18 0 |

## ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 270,000 | Anglo-Argentine Trams, Nos. 260,009 to 510,007, and 560,008 to 580,007 | 5 | .. | 8 % | 8 % | 8 % | 7 15/16 — 8 1/16 xd | 7⅞— 8 | 8 | 7 15/16 | —1/16 | 5 0 0 |
| 260,007 | Do. 5½ % Cum. Pref., 1 to 260,007 .. | 5 | 5½% | 5½% | 5½% | 5½% | 5 15/16 — 6 1/16 | 5 15/16 — 6 1/16 | 6 1/16 | 5 15/16 | .. | 4 8 11 |
| 266,600 | Do. Permanent, 6 % Deb. Stock, 1888 | 100 | 6 % | 6 % | 6 % | 6 % | 131 —134 | 131 —134 | .. | .. | .. | 4 9 7 |
| 285,100 | Auckland E. Trams, 5 % 1st Mort. Deb. Stock .. | 100 | 5 % | 5 % | 5 % | 5 % | 102 —105 | 102 —105 | .. | .. | .. | 4 15 8 |
| 590,000 | Babcock & Wilcox, 1 to 590,000 .. .. .. | 1 | 17 % | 20 % | 20 % | 20 % | 3⅞— 4 | 3⅞— 3 15/16 xd | 7 6/8 | 7 3/8 | — 1/8 | 5 3 3 |
| 100,000 | Do. do. 6 % Cum. Pref., 1 to 100,000 .. | 1 | 6 % | 6 % | 6 % | 6 % | 1 1/16 — 1 1/8 xd | 1 1/16 — 1 1/8 | .. | .. | .. | 3 16 10 |
| 38,000 | British Aluminium, Ord., 2,001 to 40,000 .. .. | 5 | .. | 7 % | 7 % | 7 % | 4 — 5 | 4 — 5 | 8 0/- | .. | .. | 7 0 0 |
| 40,000 | Do. do. 7 % Cum. Pref. .. .. .. | 5 | Nil | 7 % | 7 % | 7 % | 4⅞— 5⅛ | 4⅞— 5⅛ | 5 1/16 | .. | .. | 6 10 8 |
| 20,000 | Do. do. "A" 6 % Cum. Pref. .. .. | 5 | Nil | 6 % | 6 % | 6 % | 4⅜— 5 | 4⅜— 5 | .. | .. | .. | 6 0 0 |
| 20,000 | Do. do. 4 % Funding Certs. .. .. | 5 | .. | 4 % | 4 % | 4 % | 3⅞— 4⅛ | 3⅞— 4⅛ | .. | .. | .. | 4 14 1 |
| 258,000 | Do. do. 5 % 1st Mort. Deb. Stock Red. | Stock | 5 % | 5 % | 5 % | 5 % | 100 —103 | 100 —103 | .. | .. | .. | 4 17 1 |
| 300,000 | Do. do. 5½ % Loch Leven Debs. .. | 100 | .. | .. | .. | 5½% | 96 — 99 | 96 — 99 | 97⅜ | .. | .. | 5 11 1 |
| 400,000 | British Columbia E. Rail Def. Ord. Stock .. | 100 | 6 % | 6 % | 6 % | 6 % | 130 —135 | 130 —135 | .. | .. | .. | 4 8 11 |
| 300,000 | Do. 5 % Pref. Ord. Stock .. .. .. | 100 | 5 % | 5 % | 5 % | 5 % | 113 —117 | 113 —117 | .. | .. | .. | 4 5 6 |
| 300,000 | Do. 5 % Cum. Perp. Pref. Stock .. .. | 100 | 5 % | 5 % | 5 % | 5 % | 104 —107 | 104 —107 | 106⅛ | .. | .. | 4 13 6 |
| 238,000 | Do. 4½ % 1st Mort. Debs., 1 to 6,250 .. .. | 40 | 4½% | 4½% | 4½% | 4½% | 100 —103 | 100 —103 | .. | .. | .. | 4 7 5 |
| 220,000 | Do. 4½ % Vancouver Power Debs., 1 to 2,200 | 100 | 4½% | 4½% | 4½% | 4½% | 102 —104 | 102 —104 | 94 | .. | .. | 4 6 7 |
| 133,301 | British Electric Traction .. .. .. .. | 10 | 6 % | 6 % | 8 % | Nil | 1⅞— 2⅜ | 1⅞— 2⅛ | 41/3 | 36/3 | — 1/3 | Nil |
| 161,437 | Do. do. 6 % Cum. Pref. .. .. .. | 10 | 6 % | 6 % | 6 % | 6 % | 5⅛ — 6⅜ | 5⅛ — 6 | 6 | 5 11/32 | — ⅜ | 10 0 0 |
| 1,448,653 | Do. do. 5 % Perp. Deb. Stock .. | Stock | 5 % | 5 % | 5 % | 5 % | 97 —100 xd | 97 —100 | 97⅜ | .. | .. | 5 0 0 |
| 410,178 | Do. do. 4½ % 2nd Deb. Stock Red. | 100 | .. | 4½% | 4½% | 4½% | 78 — 81 | 78 — 81 | .. | .. | .. | 5 11 1 |
| 100,000 | British Insulated and Helsby Cables .. .. | 5 | 8 % | 8 % | 8 % | 10 % | 6⅞— 7 xd | 6⅞— 7 | .. | .. | .. | 7 2 10 |
| 100,000 | Do. do. 6 % Cum. Pref. .. .. .. | 5 | 6 % | 6 % | 6 % | 6 % | 5⅝— 6⅛ | 5⅝— 6⅛ | 5⅝ | .. | .. | 4 18 0 |
| 500,000 | Do. do. 4½ % 1st Mort. Deb. Red.. .. | 100 | 4½% | 4½% | 4½% | 4½% | 101 —104 | 101 —104 | .. | .. | .. | 4 6 7 |
| 212,000 | British Thomson-Houston 4½ % 1st Mort. Debs. .. | 100 | 4½% | 4½% | 4½% | 4½% | 85 — 89 xd | 85 — 89 | .. | .. | .. | 4 18 11 |
| 400,000 | British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000 | 5 | 6 % | Nil | Nil | .. | 1 — 1⅛ | 1 — 1⅛ | .. | .. | .. | Nil |
| 1,016,358 | Do. do. 4 % Mort. Deb. Stock .. | 100 | 4 % | 4 % | 4 % | 4 % | 62 — 67 | 62 — 67 | .. | .. | .. | 5 19 5 |
| 50,000 | ‡Browett, Lindley & Co., Ord. .. .. .. | £1 | Nil | Nil | Nil | .. | 1/16 — 1/8 | 1/16 — 1/8 | .. | .. | .. | Nil |
| 50,000 | ‡ Do. do. 6 % Cum. Pref. .. .. | £1 | Nil | Nil | Nil | .. | 14/6 to 15/6 | 14/6 to 15/6 | .. | .. | .. | Nil |
| 105,731 | Brush Electrical Engineering, Ord., 1 to 105,731 .. | 2 | Nil | Nil | 2½% | Nil | 1/8 — 3/8 | 1/8 — 3/8 | .. | .. | .. | Nil |
| 150,000 | Do. do. Non-cum. 6 % Pref. .. | 2 | 6 % | 6 % | 6 % | Nil | 1/8 — 1½ | 1/8 — 1½ | .. | .. | .. | Nil |
| 125,000£ | Do. do. 4½ % Perp. Deb. Stock .. | Stock | 4½% | 4½% | 4½% | 4½% | 83 — 86 | 83 — 86 | .. | .. | .. | 5 4 8 |
| 125,000£ | Do. do. 4½ % Perp. 2nd Deb. Stock.. | Stock | 4½% | 4½% | 4½% | 4½% | 68 — 71 | 67 — 70 | .. | .. | —1 | 6 8 7 |
| 100,000 | Buenos Ayres & Belgrano, 1 to 100,000 .. .. | 5 | 3 % | 4 % | 3 % | 3 % | 4⅛— 4½ | 4⅛— 4½ | 90/- | .. | .. | 3 4 0 |
| 40,000 | Do. do. "A" 6 % Cum. Pref., 1 to 40,000 | 5 | 6 % | 6 % | 6 % | 6 % | 4⅛— 5⅛xd | 4⅛— 5⅛ | .. | .. | .. | 5 14 3 |
| 27,500 | Do. do. "B" do., 1 to 27,500 .. .. | 5 | 6 % | 6 % | 6 % | 6 % | 4⅛— 5⅛xd | 4⅛— 5⅛ | .. | .. | .. | 5 14 3 |
| 13,200 | Do. do. 5 % Deb. Stock .. .. .. | 100 | 5 % | 5 % | 5 % | 5 % | 105 —115 | 105 —115 | .. | .. | .. | 4 6 11 |
| 190,000 | Do. do. 5 % 2nd Deb. Stock .. .. | 100 | 5 % | 5 % | 5 % | 5 % | 102 —105 | 102 —105 | .. | .. | .. | 4 15 3 |
| 137,610 | Calcutta Trams, 1 to 137,610 .. .. .. | 5 | 6 % | 8 % | 8 % | 8 % | 7 — 7⅛ | 7 — 7⅛ | 7⅛ | .. | .. | 5 6 8 |
| 30,000 | Do. 5 % Cum. Pref., Nos. 1 to 29,880.. | 5 | .. | .. | 5 % | 5 % | 5 — 5⅛ | 5 — 5⅛ | .. | .. | .. | 4 10 11 |
| 850,000 | Do. 4½ % 1st Deb. Stock.. .. .. | 100 | 4½% | 4½% | 4½% | 4½% | 102 —106 | 102 —106 | 103½ | 103 | .. | 4 4 11 |
| 85,000 | Callender's Cable Construction shares .. .. | 5 | 12½% | 12½% | 15 % | 15 % | 9⅜— 10⅜ | 9⅜ — 10⅜ | 10⅛ | .. | .. | 7 0 0 |
| 40,000 | Do. do. 5 % Cum. Pref. .. .. .. | 5 | 5 % | 5 % | 5 % | 5 % | 5⅛— 5⅜ | 5⅛ — 5⅜ | .. | .. | .. | 4 6 11 |
| 300,000 | Do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | 4½% | 4½% | 4½% | 4½% | 105⅛—107⅛ | 105⅛—107⅛ | .. | .. | .. | 4 3 4 |
| 491,222 | Cape E Trams., 1 to 491,222 .. .. .. | 1 | 10 % | 5 % | Nil | .. | 1/8 — 3/8 | 1/8 — 3/8 | .. | .. | .. | Nil |
| 450,000 | Castner-Kellner Alkali, 1 to 450,000 .. .. | 1 | 4 % | 4 % | 6 % | 8 % | 1 1/16 — 1 3/16 | 1 1/16 — 1 3/16 | 25/3 | .. | .. | 6 1 |
| 224,988 | Do. do. 4½ % 1st Mort. Deb. Stock | 100 | 4½% | 4½% | 4½% | .. | 97 —102 | 97 —102 | 100 | .. | .. | 4 8 3 |
| 911,568 | Central London Railway, Ord. Stock .. .. | Stock | 4 % | 4 % | 4 % | 4 % | 63 — 65 | 63 — 65 | 64⅜ | 64 | .. | 6 3 1 |
| 544,216 | Do. do. 4 % Pref. Stock .. .. | Stock | 4 % | 4 % | 4 % | 4 % | 88 — 90 | 88 — 90 | .. | .. | .. | 4 8 11 |
| 544,216 | Do. do. Def. do. .. .. | Stock | 4 % | 4 % | 4 % | 4 % | 45 — 48 | 45 — 48 | .. | .. | .. | 8 6 8 |
| 1,480,000 | City and South London Railway .. .. .. | Stock | 2⅜% | 2⅛% | 1¾% | 2⅛% | 45 — 47 | 45 — 47 | 46⅜ | 46⅛ | .. | 4 10 5 |

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

(Continued on next page.)

## SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

### ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

| Present Issue. | NAME. | Stock or Share. | Dividends for the last four years. | | | | Closing Quotations Oct. 1st. | Closing Quotations Oct. 8th. | Business done week ended Oct. 8th, 1907. | | Rise + or Fall — | Present Yield per cent. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | * | 1903. | 1904. | 1905. | 1906. | | | Highest | Lowest. | | £ s. |
| 85,000 | Crompton & Co., Nos. 1 to 85,000 | 8 | 2½% | 2½% | 2½% | 5 % | 1⅞— 2 | 1⅞— 2 | .. | .. | .. | 7 5 5 |
| 100,000 | Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red. | .. | 5 % | 5 % | 5 % | 5 % | 96 — 99 | 96 — 99 | .. | .. | .. | 5 1 0 |
| 260,000 | Dick, Kerr & Co., 1 to 260,000 | 1 | .. | 10 % | 10 % | 10 % | 1¼— 1⅛ xd | 1¼— 1⅛ | .. | .. | .. | 6 13 4 |
| 305,000 | Do. do. 6 % Cum. Pref., 1 to 305,000 | 1 | 6 % | 6 % | 6 % | 6 % | 1 — 1⅛ xd | 1 — 1⅛ | .. | .. | .. | 4 16 0 |
| 294,150 | Do. do. 4½ % Deb. Stock | 100 | 4½% | 4½% | 4½% | 4½% | 101 —104 | 101 —104 | .. | .. | .. | 4 6 7 |
| 60,000 | Dublin United Trams. (1896), 1 to 60,000 | 10 | 5½% | 6 % | 6% | 6 % | 13 — 14 | 13 — 14 | .. | .. | .. | 4 5 9 |
| 59,987 | Do. 6 % Pref. between 1 and 60,000 | 10 | 6 % | 6 % | 6 % | 6 % | 12⅞— 13⅛ | 12⅞— 13⅛ | .. | .. | .. | 4 7 8 |
| 99,261 | Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261 | 5 | Nil | 2½% | 4½% | .. | 1 1/16— 1 1/16 | 1 1/16— 1 1/16 | 17/6 | .. | .. | 9 8 3 |
| 17,139 | Do. "A" shares, 01—017,139 | 5 | Nil | 2½% | 4½% | .. | 2¼— 2⅜ | 2¼— 2⅜ | .. | .. | .. | 8 6 9 |
| 319,475 | Do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 4 % | 83 — 85 | 83 — 85 | .. | .. | .. | 4 14 2 |
| 72,220 | Do. 5 % 2nd Deb. Stock Prov. Certs. all pd. | 100 | 5 % | 5 % | 5 % | 5 % | 87 — 90 xd | 87 — 90 | .. | .. | .. | 5 11 1 |
| 112,100 | Electric Contruction, 1 to 112,100 | 2 | 4 % | Nil | Nil | Nil | 1/8— 3/8 | 1/8— 3/8 | .. | .. | .. | Nil |
| 31,390 | Do. do. 7 % Cum. Pref., 1 to 31,390 | 2 | 7 % | 7 % | 7 % | Nil | ¾— 1 | ¾— 1 | .. | .. | — ¼ | Nil |
| 25,000 | General Electric Co. (1900), 5 % Cum. Pref. | 10 | 4 % | 5 % | 5 % | 5 % | 8 — 8½ | 8 — 8½ | .. | .. | .. | 5 17 8 |
| 200,000 | Do. do 4 % Mort Deb. | Stock | 4 % | 4 % | 4 % | 4 % | 90 — 93 xd | 90 — 93 | .. | .. | .. | 4 6 0 |
| 78,000 | Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000 | 10 | 3 % | 4 % | 4 % | 4 % | 1½— 2 xd | 1½— 1⅝ | 28/9 | .. | .. | 20 0 0 |
| 96,000 | Greenwood & Batley, 7 % Cum. Pref. | 10 | 7 % | 7 % | 7 % | 7 % | 10½ — 10⅝ | 10¼— 10⅝ | .. | .. | .. | 6 10 3 |
| 80,000 | Do. do. 5 % Mort. Debs. | 100 | 5 % | 5 % | 5 % | 5 % | 102 —103 | 102 —103 | .. | .. | .. | 4 17 1 |
| 200,000 | Henley's (W. T.), Telegraph Works, Ord. | 5 | 15 % | 15 % | 15% | 15 % | 11 — 12 | 11 — 12 | .. | .. | .. | 6 5 0 |
| 200,000 | Do. do. 4½ % Pref. | 5 | 4½% | 4½% | 4½% | 4½% | 5 — 5½ xd | 5 — 5½ | .. | .. | .. | 3 17 3 |
| 150,000 | Do. do. 4½ % Mort. Deb. Stock | Stock | 4½% | 4½% | 4½% | 4½% | 105½—107½ | 105½—107½ | .. | .. | .. | 4 3 9 |
| 50,000 | India-Rubber, Gutta-percha & Telegraph Works. | 10 | 10% | 5 % | 10% | 10 % | 14½ — 15¼ | 14½ — 15¼ | 15⅝ | 15½ | .. | 6 13 4 |
| 37,500 | †Liverpool Overhead Railway, Ord. | 10 | 1⅜% | 1½% | Nil | Nil | 1½— 1⅞ | 1½— 1⅞ | .. | .. | .. | Nil |
| 10,000 | † Do. do. Pref., fully paid | 10 | 5 % | 5 % | 5 % | 5 % | 7½ — 8 | 7½ — 8 | .. | .. | .. | 5 14 11 |
| 600,070 | London United Trams. (1901), 1 to 50,007 | 10 | 8 % | 6 % | 3 % | 3 % | 6½ — 7½ | 6⅝ — 7⅛ | .. | .. | .. | 4 0 0 |
| 399,930 | Do. do. 60,008 to 100,000 | 10 | 8 % | 6 % | 3 % | 3 % | 6¼ — 7⅛ | 6¼ — 7⅛ | .. | .. | .. | 4 0 0 |
| 125,000 | Do. do. 5 % Cum. Pref., 1 to 125,000 | 10 | 5 % | 5 % | 5 % | 5 % | 7⅞ — 8½ | 7⅞ — 8⅝ xd | .. | .. | .. | 5 14 3 |
| 1,331,000 | Do. do. 4 % 1st Mort. Deb. Stock | 100 | 4 % | 4 % | 4 % | 4 % | 82 — 86 | 82 — 86 | .. | .. | .. | 4 13 0 |
| 314,016 | Metropolitan Electric Trams., Defd. | 1 | Nil | Nil | Nil | Nil | 1/16— 3/16 | 1/16— 3/16 | 1/6 | .. | .. | Nil |
| 500,000 | Do. do. 5 % Cum. Pref. | 1 | 5 % | 5 % | 5 % | 5 % | 3/32— 3/16 | 3/32— 3/16 | 17/9 | 16/10½ | .. | 5 2 7 |
| 350,000 | Do. do. 4½ % Deb. Stock Red. | 100 | .. | 4½% | 4½% | 4½% | 94 — 97 | 94 — 97 | .. | .. | .. | 4 10 11 |
| 245,500 | Potteries E. Trc. | 1 | 5 % | 5 % | 4 % | 4 % | 1/16— 1/8 | 1/16— 1/8 | .. | .. | .. | 8 0 0 |
| 245,500 | Do. 5 % Cum. Pref. | 1 | 5 % | 5 % | 5 % | 5 % | 3/16— 1/4 | 3/16— 1/4 | .. | .. | .. | 6 13 4 |
| 245,000 | Do. 4½ % Deb. Stock | 100 | 4½% | 4½% | 4½% | 4½% | 95 — 98 | 95 — 98 | .. | .. | .. | 4 11 10 |
| 37,350 | Telegraph Construction and Maintenance | 12 | 20 % | 15 % | 15 % | 15 % | 30½ — 32½ | 30 — 32 | 30½ | 30 | — ½ | 5 18 2 |
| 150,000 | Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909 | 100 | 4 % | 4 % | 4 % | 4 % | 99½—102½ | 99½—102½ | 100¼ | .. | .. | 3 18 1 |
| 599,200 | Undergd. E. R., Lon., 5 % Profit Shar. S. Nts. | .. | .. | 5 % | 5 % | 5 % | 55 — 58 | 55 — 58 | .. | .. | .. | 8 14 1 |
| 66,666 | Willans & Robinson, 1 to 30,000 & 80,001 to 116,666 | 5 | 3 % | Nil | Nil | .. | 1⅛— 1⅜ | 1⅛— 1⅜ | .. | .. | .. | Nil |
| 66,666 | Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666 | 5 | 6 % | Nil | Nil | .. | 3⅜— 4⅛ | 3⅜— 4⅛ | 85/- | .. | .. | Nil |
| 246,574 | Do. 4 % 1st Mort. Deb. Stock | 100 | 4 % | 4 % | 4 % | 4 % | 76 — 80 | 74 — 78 | 75½ | 75 | .. | 5 2 7 |

### ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14,000 | Bromley (Kent) E.L. & P,. 1 to 14,000 | 5 | 5 % | 5½% | 5½% | 5½% | 4⅝— 5⅛ xd | 4⅝— 5⅛ | .. | .. | .. | 5 7 4 |
| 70,000 | Do. do. 4½ % 1st. deb. stock | 100 | 4½% | 4½% | 4½% | 4½% | 98 —100 | 98 —100 | 99 | 98½ | .. | 4 10 0 |
| 29,798 | Brompton & Kens. Elec. Lt. Sup., Ord., ₣ to 20,000 | 5 | 10 % | 10 % | 10 % | 10% | 7⅞— 8 | 7¼— 8¼ | .. | .. | .. | 6 13 4 |
| 10,202 | Do. do. 7 % Cum. Pref. | 5 | 7 % | 7 % | 7 % | 7 % | 7¼— 8¼ | 7¼— 8¼ | .. | .. | .. | 4 4 10 |
| 396,876 | Central Electric Supply 4 % Guar. Deb. Stock | 100 | 4 % | 4 % | 4 % | 4 % | 99 —102 | 99 —102 | .. | .. | .. | 3 18 5 |
| 80,000 | Charing Cross and Strand Electricity Supply | 5 | 8 % | 8 % | 5 % | 5 % | 3⅝— 4⅛ | 3⅝— 4⅛ | 81/3 | 72/6 | .. | 6 1 3 |
| 80,000 | Do. do. 4½ % Cum. Pref. | 5 | 4½% | 4½% | 4½% | 4½% | 3⅝— 3⅞ | 3⅝— 4 | 76/- | 70/- | + ⅛ | 5 12 6 |
| 80,000 | Do. "City Undertaking" 4½ % Cum. Prf. | 5 | 4½% | 4½% | 4½% | 4½% | 3⅝— 3¾ | 3⅝— 3⅞ | .. | .. | .. | 5 16 2 |
| 427,400 | Do. do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 4 % | 96 — 99 | 96 — 99 | 97 | .. | .. | 4 0 10 |
| 49,436 | Chelsea Electricity Supply, Ord. | 5 | 5½% | 6 % | 6 % | 4½% | 3¼— 4¼ | 3¼— 4¼ | .. | .. | .. | 5 5 11 |
| 175,000 | Do. do. 4½ % Deb. Stock Red. | Stock | 4½% | 4½% | 4½% | 4½% | 102 —105 | 102 —105 | 104½ | .. | .. | 4 5 9 |
| 70,595 | City of London Elec. Lighting, Ord. 40,001—110,595 | 10 | 5 % | 6 % | 6 % | 6 % | 9 — 10 | 9 — 10 | 9 1/16 | .. | .. | 6 0 0 |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 | 10 | 6 % | 6 % | 6 % | 6 % | 10½— 11½ | 10½— 11½ | 10 1/16 | .. | .. | 5 4 4 |
| 400,000 | Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd. | .. | 5 % | 5 % | 5 % | 5 % | 122 —125 | 122 —125 | .. | .. | .. | 4 1 4 |
| 800,000 | Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd. | 100 | 4½% | 4½% | 4½% | 4½% | 97 —100 | 97 — 100 | 99 | .. | .. | 4 10 0 |
| 40,000 | County of Durham Electrical Power, Ord. | 5 | 4 % | £3 7 0 | 4 % | 4 % | 4½— 5 | 4½— 5 | .. | .. | .. | 4 0 0 |
| 50,000 | Do. do. do. 5 % Pref. | 5 | 5 % | 5 % | 5 % | 5 % | 4½— 5 | 4½— 5 | .. | .. | .. | 5 0 0 |
| 40,000 | County of London Electric Lighting, Ord. 1—40,000 | 10 | 4 % | 4½% | 5 % | 5 % | 6½— 7⅜ | 6½— 7⅜ | .. | .. | .. | 6 9 0 |
| 40,000 | Do. do. 6 % Pref., 40,001—60,000 | 10 | 6 % | 6 % | 6 % | 6 % | 10 — 11 | 10 — 11 | 10½ | .. | .. | 5 9 1 |
| 400,000 | Do. do. 4½ % Deb. Stock | .. | 4½% | 4½% | 4½% | 4½% | 106 —109 | 106 —109 | 108½ | .. | .. | 4 2 7 |
| 400,000 | Do. do. 4½ % 2nd. Deb. Stock | Stock | 4½% | 4½% | 4½% | 4½% | 96 — 99 | 96 — 99 | 99 | 97 | .. | 4 10 11 |
| 80,000 | Edmundson's Electric Corporation, Ord. Shares | 5 | 7 % | 7 % | 4 % | Nil | ¼— 1 | ¼— 1 | .. | .. | .. | 11 0 0 |
| 80,000 | Do. do. 6 % Cum. Pref. | 5 | 6 % | 6 % | 6 % | 3 % | 1½— 2 | 1½— 2 | 30/- | 27/6 | .. | 7 10 0 |
| 350,000 | Do. do. 4½ % 1st Mort. Deb. Stk. | 100 | 4½% | 4½% | 4½% | 4½% | 76 — 81 | 76 — 81 | .. | .. | .. | 5 11 1 |
| 10,000 | Folkestone, 1 to 10,000 | 5 | 5½% | 5½% | 5½% | 5½% | 4⅜— 5⅛ xd | 4⅜— 5⅛ | .. | .. | .. | 5 4 9 |
| 10,000 | Do. 5 % Cum. Pref., 1 to 10,000 | 5 | .. | .. | 5 % | 5 % | 4⅞— 5⅛ xd | 4⅞— 5⅛ | .. | .. | .. | 4 13 0 |
| 90,000 | Do. 4½ % 1st Deb. Stock | 100 | 4½% | 4½% | 4½% | 4½% | 96 — 99 | 96 — 99 | .. | .. | .. | 4 10 11 |
| 13,000 | Hove, 1 to 13,000 | 5 | 8½% | 8½% | 9 % | 9 % | 6⅞— 7⅛ | 6⅞— 7⅛ | .. | .. | .. | 6 4 2 |
| 21,000 | Kensington and Knightsbridge Electric Ord. | 5 | 12½ % | 12 % | 10 % | 10 % | 8½ — 9⅛ | 8½ — 9⅛ | .. | .. | .. | 5 8 1 |
| 90,000 | Do. do. do. 4 % Deben. Stk. | Stock | 4 % | 4 % | 4 % | 4 % | 94 — 97 | 94 — 97 | .. | .. | .. | 4 2 6 |
| 111,000 | London Electric Supply Corporation, Limited, Ord. | 3 | Nil | 3 % | 4 % | 4 % | 1⅛— 1⅜ | 1⅛— 1⅜ | .. | .. | .. | 6 16 2 |
| 70,000 | Do. do. do. 6 % Pref. | 5 | 6 % | 6 % | 6 % | 6 % | 4¼— 4⅜ | 4¼— 4⅜ | .. | .. | .. | 6 6 4 |
| 374,395 | Do. do. 4 % 1st Mort. Deb. Stock | Stock | 4 % | 4 % | 4 % | 4½% | 88 — 92 | 89 — 93 | .. | .. | +1 | 4 16 9 |
| 200,000 | Metropolitan Electric Supply, 1 to 100,000 | 5 | 8⅜% | 10 % | 10 % | 8 % | 5⅛— 5⅜ | 5⅛— 5⅜ | 5 1/16 | .. | .. | 6 19 2 |
| 76,121 | Do. 4½ % Cum. Pref. 1—71,106 | 5 | 4½% | 4½% | 4½% | 4½% | 4⅝— 5⅛ | 4⅝— 5⅛ | 5 1/16 | 98/9 | .. | 4 7 10 |
| 220,000 | Do. 4½ % 1st Mort. Deben. Stock | .. | 4½% | 4½% | 4½% | 4½% | 103 —107 | 103 —107 | 5 1/16 | .. | .. | 4 10 0 |
| 250,000 | Do. 3½ % Mort. Deben. Stock Redem. | Stock | 3½% | 3½% | 3½% | 3½% | 87 — 92 | 87 — 92 | .. | .. | .. | 3 16 1 |
| 250,000 | Midland Electric Corporation, 4½ % 1st Mort. Deb. | 100 | 4½% | 4½% | 4½% | 4½% | 95 — 98 | 95 — 98 | .. | .. | .. | 4 11 10 |
| 67,991 | Newcastle-on-Tyne | 5 | 8 % | 8 % | 8 % | 8 % | 6⅛— 6⅜ | 6⅛— 6⅜ | .. | .. | .. | 5 18 6 |
| 75,000 | Do. 5 % Pref., 1 to 75,000 | 5 | 5 % | 5 % | 5 % | 5 % | 5 — 5⅛ | 5 — 5⅛ | .. | .. | .. | 4 10 11 |
| 10,852 | Notting Hill Electric Lighting | 10 | 6 % | 7 % | 7½% | 7½% | 11 — 12 | 11 — 12 | .. | .. | .. | 6 5 0 |
| 20,000 | Oxford, 1 to 96 and 407 to 20,310 | 5 | 6⅔% | 7 % | 7 % | 7 % | 5½— 6 | 5½— 6 | .. | .. | .. | 5 16 8 |
| 50,000 | Do. 4 % Deb. Stock | 100 | 4 % | 4 % | 4 % | 4 % | 95 — 97 | 95 — 97 | .. | .. | .. | 4 2 6 |
| 40,000 | St. James' and Pall Mall Electric Light, Ord. | 5 | 14½% | 14½% | 12½% | 10 % | 7½— 8½ | 7½— 8½ | .. | .. | .. | 6 1 3 |
| 20,000 | Do. do. 7 % Pref. 20,061 to 40,060 | 5 | 7 % | 7 % | 7 % | 7 % | 6½— 7⅜ | 6½— 7⅜ | .. | .. | .. | 4 14 11 |
| 150,000 | Do. do. 3½ % Deb. Stock Red. | 100 | 3½% | 3½% | 3 % | 3½% | 86 — 91 | 86 — 91 | .. | .. | .. | 3 16 11 |
| 12,000 | Smithfield Markets Electric Supply, Ord. | 5 | 4 % | 4 % | 4 % | Nil | ⅛— 1⅛ | ⅛— 1⅛ | .. | .. | .. | Nil |
| 50,000 | Do. do. do. 4 % Deb. Stock | Stock | 4 % | 4 % | 4 % | 4 % | 71 — 75 | 71 — 75 | .. | .. | .. | 6 0 0 |
| 65,000 | South London Electricity Supply, Ord. | 5 | 3 % | 4 % | 4 % | 3 % | 1⅞— 2⅛ | 1⅞— 2⅛ | .. | .. | .. | 6 6 4 |
| 120,000 | South Met. Elec. Lt. & Power, Ord. | 1 | Nil | Nil | 2½% | 2½% | ⅜— ½ | ⅜— ½ | .. | .. | — 1/16 | 3 6 8 |
| 117,968 | Do. do. 7 % Pref. | 1 | 7 % | 7 % | 7 % | 7 % | 1⅛— 1⅜ | 1⅛— 1⅜ | .. | .. | +1 | 5 17 11 |
| 200,000 | Do. do. 4½ % 1st Deb. Stk. | 100 | 4½% | 4½% | 4½% | 4½% | 98 —101 xd | 99 —102 | .. | .. | .. | 4 8 3 |
| 80,000 | Urban Electric Supply, Ord. | 5 | 5 % | 5 % | 5 % | 5 % | 1⅞— 2⅛ xd | 1⅞— 2⅛ | 31/3 | 28/9 | .. | 11 10 6 |
| 50,000 | Do. do. 5 % Cum. Pref. | 5 | 5 % | 5 % | 5 % | 5 % | 1¾— 2⅛ xd | 1¾— 2⅛ | .. | .. | .. | 8 13 11 |
| 200,000 | Do. do. 4½ % 1st Mort. Db. Stk. Red. | 100 | .. | 4½% | 4½% | 4½% | 92 — 95 xd | 92 — 95½ | .. | .. | .. | 4 14 9 |
| 110,000 | Westminster Electric Supply, Ord. | 5 | 13⅓% | 14 % | 13 % | 12 % | 8¼— 8½ | 8¼— 9 | 8 2/16 | 8⅜ | .. | 6 9 9 |
| 81,279 | Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905) | 5 | 5 % | 5 % | 5 % | 4½% | 4¼— 5⅛ | 4¼— 5⅛ | .. | .. | .. | 4 3 9 |

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

**Bank rate of Discount 4½ per cent., August 15th 1907.**

## REVIEWS.

*Steam Boilers and Supplementary Appliances.* By William H. Fowler. Manchester: The Scientific Publishing Co. 1907. Price 12s. 6d.

The author of this book could hardly fail to write a good book on steam boilers, for many years of his life were spent in the very heart of the boiler-making world, and in the closest daily contact with the leading boiler inspection society. His judgment on details of boiler construction and upon the fitness of materials for boiler making is, therefore, based on the best of experience, and because of this and his independence of boiler making, we should have liked to see a much more decided and emphatic condemnation of cast-iron and of malleable cast-iron than appears on the opening pages, while at the same time in view of the movement in favour of wrought-iron something more on modern wrought-iron might have been added with advantage. Otherwise, in such brief space as can be spared to materials, the section on materials is excellent, notably the part dealing with copper.

In Chapter II, which deals with strength, it will naturally be expected that the author will be at his best, for it is primarily on the strength of steam boilers that boiler insurance and inspection has necessarily centered. Nor will the reader be disappointed in this expectation. In the chapter on setting, we note that "overflueing" of the Lancashire boiler is not approved by the author; on this point we think that temperature tests are lacking to determine whether the gas in the overflue space is really so much hotter than the boiler as to render the system at all dangerous. At the same time, except as a safeguard against radiation loss, we do not know that there is much positive economy in overflueing.

Most of the standard types of boiler will be found illustrated, and not a few that are hardly up to the class of standard. The known danger of vertical boilers also appears to be well explained, as due rather to careless making by third-rate firms than to inherent faultiness. In this class there are now many recent examples that are the outcome of the motor wagon industry. Speaking of locomotive boilers, their enormous performance on the road as compared with their stationary output is rightly set down to vibration, and gives food for thought.

The remarks on the underfiring of shell boilers are good, and we could have wished that the space available for boilers proper had been greater. One-third of the volume alone is devoted to the boiler, the remaining 400 pages dealing with the supplementary appliances, including a very good chapter on valves, in which we are glad to find the author in favour of the use of valves smaller in their thoroughfare than the pipes in which they are placed. We cannot see that a short valve with tapered approach and outlet can reduce the pressure at all seriously, but it will help largely to reduce cost.

There is an excellent chapter on steam pipes; reducing valves are described very fully, as are also feed heaters and pumps. We note with satisfaction the author's attitude on feed heating with boiler steam, and his explanation of the benefits of this apparently paradoxical process.

Chapter XX deals with filters and water softeners in a descriptive manner. The next chapter also, on superheating, is not much more than descriptive, and contains little on the important point of temperature control.

In Chapter XXII we find fuels treated upon, and there is a good table of British coals and their value in B.TH.U. The treatment of fuel and combustion is good so far as it goes, but might with advantage have been extended so far as regards the treatment of, and conditions necessary for, the bituminous coals, though what is said may be sufficient for the expert.

Types of mechanical stoker are described categorically, after which comes a chapter on draught, and next one on oil fuel, largely derived from the report of the U.S. Naval Liquid Fuel Board.

The chapter on corrosion of boilers we hardly need say is based on the closest of actual experience, as also that on structural and other defects, furnace hoops, screw stays, and bad fittings. Chapter XXX deals with hydraulic tests, than which there is no worse test if badly applied, as it is so often, especially in America, where an ill-informed policeman drives up in a van, applies a hydraulic test to a boiler, very frequently overstrains it, and leaves it with a certificate of safety and a surety of danger. Further chapters deal with boiler trials, boiler inspectors and inspection, and, finally, there is a most full and copious index.

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*The Corpuscular Theory of Matter.* By J. J. Thomson, M.A., F.R.S., D.Sc., &c. London: Constable & Co. 1907. Price 7s. 6d. net.

It is stated in the preface that this book is an expansion of the series of lectures delivered at the Royal Institution in the spring of 1906.

The book consists of seven chapters which deal respectively with the origin and properties of corpuscles, the two different corpuscular theories of metallic conduction, and in the number and arrangement of corpuscles in the atom.

In the first chapter corpuscles in vacuum tubes are considered, and evidence is given showing that the corpuscles act as carriers of electricity, and that a positively electrified body owes its positive electrification to a defect of corpuscles. Also a positive charge is always associated with a mass comparable to that of the hydrogen or helium atom, whereas the corpuscles appear always to have the same mass, viz., that of about $\frac{1}{1700}$ the atom of hydrogen.

As is well known, the positive ions are given off by radium, and constitute the "X" rays. These have been examined by Rutherford and others, and the ratios of $\frac{e}{m}$ measured.

The second chapter deals with the origin of the corpuscle, and here all the arguments are carefully set forth, and these tend to show that its mass is wholly electrical in origin.

The evidence for the existence of corpuscles afforded by the Zeeman effect is discussed in a most luminous manner.

The chapters of most interest to electrical engineers are IV and V, in which the two theories of metallic conduction of electricity are most carefully explained. These are very interesting indeed, and the mathematics used is not too heavy.

The first of these theories assumes that the corpuscles are in temperature equilibrium with their surroundings, and that the "drift" of the corpuscles which constitutes the electric current, is started and maintained by the direct action of the electric field which acts on them. From considerations of the expressions derived for the conductivity of a substance, a rough estimate of the number of the corpuscles in a cubic centimetre of silver is arrived at, and the number is shown to be of the same order as the number of atoms in that volume. Again, the comparison between the ratio of the thermal to the electric conductivities gives a fairly close approximation to the results of experiment.

The anomalous behaviour of alloys is pointed out in connection with the above, and the fact that pure metals appear to tend to zero resistance at the absolute zero of temperature, whilst that of alloys seems to tend towards a definite limiting value.

Lorenz's theory of radiation is next discussed, as well as the theory of the Hall, Peltier and Thomson effects. By considering the amount of heat absorbed or developed in a junction of two dissimilar metals when a current passes through it, the ratio of the number of corpuscles in unit volume of each metal may be determined, and from the Thomson effect, the change in this number for any one metal with temperature. The number arrived at in this way for silver is $1{\cdot}8 \times 10^{24}$. It is then shown that this makes the specific heat of silver about 10 times larger than the value required by experiment.

The second theory is then considered, and in this case the corpuscles are supposed to jump from one atom to the neighbouring one. The corpuscles are here imagined to be attracted out of the atoms by the action of neighbouring atoms on them. The theory is then critically examined pretty much as in the former case, and the results are compared with results of experience.

Chapter VI is on the "Arrangement of Corpuscles in the Atom," and here we have, perhaps, the only scientific hypothesis of how the elements have acted in order that they may fit into the periodic classification of Mendeléeff and Lothar

Meyer. This chapter may well be studied by chemists and teachers. The apparatus to illustrate instability of groups consisting of a number of small magnets floating on water, could easily be constructed for a few shillings with some needles, corks, &c., and should form a useful piece of apparatus for lecture demonstration purposes.

Next forces between atoms are dealt with, and the final chapter is on the remarkable series of calculations of the number of corpuscles in an atom, size of the sphere of positive electrification, &c.

It is needless to say that this remarkable book, like all Prof. J. J. Thomson's works, is written in a singularly lucid style, and the mathematics used throughout it is not beyond that of the average student. The book will be welcomed alike by students and teachers.

To those who are interested in, and desire to keep in touch with, the trend of modern research, the possession of this book will be a *sine quâ non*.

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*The Electric Furnace in Iron and Steel Production.*—By John B. C. Kershaw, F.I.C. London: *The Electrician* Printing and Publishing Co., Ltd. 1907. Price 3s. 6d. net.

The present book appeared originally in the form of a series of articles, and these have been only slightly altered. There has been added, however, an appendix containing the dates and numbers of the more important English, American and Canadian patents, which would have been even more useful had it been more complete. As the author states in his preface, the present development of these new methods and processes is small and insignificant when compared with the vast magnitude of the iron and steel industries, but unquestionably the progress of the future is to be looked for along these lines. Water power is gradually taking the place of mechanical contrivances depending on coal, and as a result, new industrial centres are springing up depending on the electric furnace for their iron and steel production, and not on the older blast furnace. The literature on the subject of the electrical furnace is voluminous and widely distributed, and a book giving details of the innumerable modifications suggested, either useful or fantastic, would be a matter almost of impossibility. No such attempt is made by the present author, the book comprising only 70 odd pages, wherein a few of the more successful furnaces are described. Chapter I gives an account of the historical development from the time of Siemens in 1879, whose furnace was constructed capable of melting 10 kilogrammes of iron. From this modest beginning many thousands of tons of steel have been produced by the more successful processes of to-day. The subsequent chapters describe the three successful furnaces now in use—Héroult, Keller, Kjellin—and a few others whose worth has not been fully tested. As is well known, the Héroult furnace has been successfully used in Europe and America for some years for manufacturing steel from scrap iron. The actual process is described briefly by the author, giving details of cost and other useful information. Diagrams are reproduced, and these are for the most part easy of interpretation, and, in fact, the whole book is well illustrated. Chapter VII is devoted to the subject of yields and costs, and this should prove of extreme utility to both student and manufacturer. The literature on this subject alone is enormous and confusing, and any analytical survey is to be welcomed. Many figures already published have been rather of the nature of estimated cost, and not based strictly on actual trials. But in any case, it must not be overlooked that the cost of power and labour varies in different localities, and this will make it necessary to recalculate any estimates given. The author justly emphasises this, and the comparisons are made without prejudice. From this analysis it is pointed out that the three processes now in use yield results approximately of equal cost, while the Stassano and Girod furnaces have an energy consumption 50 per cent. higher; but in the latter case the trials are still in hand. The book is full of useful information from end to end, and should find a ready sale in both England and America. Unfortunately for the author the electric furnace is still in an infantile state, and is bound to develop enormously in the near future, a fact which will depreciate the permanent value of the book as a standard work. The style is that of the electro-metallurgist with a knowledge of engineering, and little chemical experience, and for that reason is not difficult to follow. The book cannot be too highly praised for its simplicity and the absence of highly technical phraseology.

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## THE ELECTRICAL SUPPLIES BUSINESS IN AMERICA.*

[Profits and the General Outlook.]

A matter of great interest to supply men and jobbers is the question of how much profit the jobbers should have on sales. This is a question often discussed, but never decided. A recent communication received from a prominent supply man connected with a well-established house, has much of interest in it, both for the supply man and the manufacturer. We quote from the correspondence as follows:—

"The concern has grown up with the electrical industry and is a fair sample of what is probably recognised as the average supply house. Not small, and not extremely large, it employs 50 hands. Its credit is high and the service given to customers is the best quality. No one can enter its employ who has not the requisite education, character and ability for advancement. Its aim has always been to please its customers, not by selling goods so cheaply that it could not afford to pay good salaries for competent employés, but by rendering prompt, intelligent service with the minimum of annoying mistakes. Its employés of six to ten years ago are now occupying all the responsible positions, and it trains its employés and pays them such satisfactory salaries that they are not looking elsewhere for positions. The largest single item of expense of this concern is that of salaries, which is about 50 per cent. of the total expense. General expenses, such as rent, insurance, advertising, lighting, heating, catalogues, packing materials, stationery, travelling expenses, &c., are about 37½ per cent. of the entire expenses, freight and hauling are 10 per cent. of expenses, postage stamps are about 2½ per cent.

"The above shows what percentage each expense bears to the total expense of doing business.

"The average cost of doing business in percentage based on the last eight years' sales is 15 per cent., which does not take into consideration the interest on capital invested, or losses on account of bad debts. The concern turns its capital about six times a year and loses about one-half of 1 per cent. on uncollectable accounts. On this basis and figuring capital as being worth 6 per cent. per annum, the cost for capital on sales amounts to 1 per cent., and by adding this and the bad debt losses to the 15 per cent., we have a total of 16½ per cent. on sales, which the jobber must receive before he can figure any profit on the business done. Inasmuch as the above percentages are based on sales and not on cost, it is readily figured that a jobber who should only add 20 per cent. to cost would come out about even on his business, after taking into consideration interest on capital invested.

"Of course, a concern which acts as manufacturers' agents and sells to other jobbers in large quantities would enjoy a lower expense rate on sales and inevitably a much lower rate of profit on such sales, but expenses and profits on these sales would not materially affect the net results in dollars and cents on what we have in mind as ordinary jobbing business.

"An up-to-date supply house must carry a stock exceeding 5,000 different lines, which come from at least 300 different factories. The jobber largely, if not entirely, absorbs what would otherwise be the factory selling costs, and at the same time places the trade in position to get goods locally from hundreds of manufacturers. The legitimate laws of trade in a line so diversified as the electrical business compels the factory to recognise and provide for the jobber, and thereby promote the manufacturer's interest by always having his goods close to the place of consumption. The most prominent and most successful manufacturers in every line of trade, almost without exception, sell their product through the jobbing houses in their particular line of trade. Conceding this to be so, why is it not desirable for the manufacturer to take into careful consideration the jobber's expenses, or what would be his expenses if he were marketing his products immediately at or near the place of use?

"The interests of the electrical business demand a high grade of intelligence, and because of this fact it is not within the proper desire of any one in the business to cripple the service rendered by cutting salaries, and as a result the efficiency of employés, in order to reduce re-sale prices. The principal opportunity and about the only opportunity the jobber has of reducing expenses, is by giving attention to his salaries, which, as already stated, amount to 50 per cent. of his entire expenses. There is no quicker road to business suicide than employing deficient help, unless it is that of selling goods at a price which does not cover the cost of doing business.

"It is, and has been, a well-established fact that the electrical manufacturing and jobbing businesses, as a whole, have not paid the profits they should. Electric railways, electric light companies, telephone and telegraph companies, on the average have been

* New York *Electrical Review*

extremely successful, but those who made and sold the supplies have not been so fortunate.

"Harmony between jobbers and manufacturers, recognising the interests of both, must exist before they reap a fair share of the profits to which they should be justly entitled, and from the above percentages of expenses it would seem that a jobber's profit, averaging 25 per cent. on all sales figured on cost or 20 per cent. if figured on sales made by him, would not be unreasonable as compared with other jobbers' profits in other lines of trade, such as the wholesale hardware trade, plumbers' supplies, &c.

"The recent wide fluctuation in the price of bar copper has created an impression in many quarters that this would affect the price of electrical supplies, particularly those which come under the schedules including receptacles, sockets, clusters, flush switches and other adaptations of brass and copper. An inquiry instituted among a number of prominent supply men appears to indicate that no change in the price of basic staples in electrical production is imminent. About a year ago a horizontal increase in the cost of electrical staples was made by the manufacturers, the supply men making a corresponding increase in their distributing charges. This increase has been maintained, and will very likely hold for at least six months more.

"Concerning the statements which have been made, that the electrical manufacturers and supply men will be caught long of high-priced copper, there seems to be no foundation in fact for this understanding. As a matter of fact, the consumers have for some time been aware that a break was near at hand, and very little 26 cent copper has been purchased. Copper has been bought on a rising market, and even where any considerable supply of copper stock at the higher prices is on hand, the profits already made will discount the losses which may be involved."

## A BUSINESS-GETTING SYSTEM FOR OLD BUILDINGS.

By PUBLICITY MAN.

The application of electricity to business purposes is strikingly illustrated in a convincing paper read by F. H. Golding before the American National Electric Light Association at Washington, and reported in the *Western Electrician*. In perusing the article, one cannot fail to observe how easily his methods may be adopted on this side, subject, of course, to local conditions. As a proof of the practicability and utility of the scheme, he refers to one central station that has been very successful in securing old-house business by these methods—has, in fact, increased such business by 700 per cent. in 18 months—proving that the use of electricity soon becomes a habit, and leads to a more extended use.

The system begins with a house-to-house canvass of the residential districts, the information received being carefully compiled and indexed in card form, and showing the street, number of house, name of owner, name of tenant or tenants, the means of illumination in use, and, if electricity is not used, whether or not the house is wired. The canvassing ought to be done intelligently and systematically, with these cards as a basis, and with the idea of concentrating effort as well as tapping every desirable quarter.

The canvasser, while sending daily reports of progress made, should be kept well supplied with literature pertaining to various lighting and power appliances for the home use. The initial method of trying to secure the entire lighting of a house being the most difficult, the canvasser should endeavour to secure an entrance in the shape of a cellar or porch light, or any other appliance that he thinks will most appeal to his prospective customer and the conditions of the neighbourhood. A liberal policy is, however, necessary, as the appliance most favoured may be something in which the current consumption is negligible. Given a foothold in a district, the agent, by a little business diplomacy, such, for instance, as utilising the enthusiastic testimonial of a pleased consumer, may further successfully extend his business. Judicious advertising in the local Press is, of course, a *sine quâ non*, care being exercised that the copy is attractive, readable, and of local bearing.

Everything, too, should be seasonable. For instance, cold nights suggest porch lights and electric radiators; the holiday season conjures up the thought of chafing dishes and coffee percolators; in the spring the young housewife's fancy turns to a general assault on the household goods, and there is a chance for fans, electric irons, and such articles.

The education of the householder would bring pressure to bear on the landlord, or estate agent, to wire their houses and thus get higher prices and easier sales, and thus a community of interests would be established. Periodical happenings, such as burglaries arouse public interest, and should be utilised by means of "Burglar" electric light pamphlets.

As a valuable adjunct to residential work, illuminated bill-boards of the picture-frame variety and easily removable, are recommended, suitable locations suggested are near car-routes, and the boards should bear reading matter and illustrations on electricity in the home. This plan, which is very sound, is not yet in general adoption over here.

Where conditions appear to warrant, the supply authority should be prepared to offer a proposal whereby the installation of wires and fixtures, in such houses as are considered in this article, may be paid for in instalments, weekly, monthly, or quarterly as may be desirable; thus many customers would be secured who might otherwise be beyond the benefits held out. If the supply authority is not available for interior wiring work, satisfactory arrangements might be made with several electrical contractors on a common basis, whereby the latter would add, say, 10 per cent. for interest, and the expense of carrying the account, to the lighting bills, the lighting authority guaranteeing the contractor against loss of capital. As the cost of the average installations will not be heavy, probably not more than £20, the percentage added will lay no great burden on the customer.

A number of central stations about the country have in effect an arrangement whereby a certain number of outlets in a house which the station staff wires is installed at or below cost, but propositions of this nature must be governed entirely by local conditions, and ought to be carefully considered. In one particular city where the lighting company installed the first work with its own wiring staff, the practice was discontinued because the contractors regarded it as a usurpation of their rights, and when asked to furnish estimates for wiring the remainder of a house would add to the estimate a sum equivalent to the assumed profit they would have received on the original work.

In another city, where the lighting company arranges with the electrical contractors to do the work and pays them the difference between the amount the customers pays and the normal price for the installation, the plan has worked out well.

In growing districts it is advisable to maintain agents exclusively for the old-house business, averaging one man to about 50,000 to 100,000 population, in accordance with the rapidity with which the town is increasing. Of course, it is essential to follow the building trade, and note estate enterprise, this being carried out by the new-house man. Especially necessary it would be to keep in touch with architects, contractors, real-estate men and solicitors, as well as constructive engineers, who might be addressed with illustrations of successful residential lighting effects, preferably local. One lighting company in a city of about 100,000 inhabitants adopted a similar plan for its new-house work, with the result that, while less than 10 per cent. of the new houses built in the city during the first five months of 1905 were wired, during the same period of the current year 92 per cent. were wired.

There seems to the writer no essential reason why methods which are so successful in America should not be equally useful in Britain, in spite of the prejudice at the present time existing—principally among municipal engineers—against "Yankee dodgery." After all, the consumer on either side of the water is a business man and a human being, with a certain number of wants and a certain amount of cash wherewith to satisfy them. The company or corporation which manages to get after that man and convince him that he really won't be happy till he has electricity, is probably doing itself much more good by adopting American methods than if it assumed a lofty and statuesque appearance of indifference to the "huckstering trade" of getting small consumers.

## EXPERIMENTS ON SOLDERING.*

A Contribution to the Testing of Materials, by Adolf Lippmann, Cologne.

(*Concluded from page* 590.)

We shall now discuss the testing of soldering materials by "electrical methods."

The soft solders usually used in electrical installation practice consist of equal portions of tin and lead, often with an addition of bismuth. This alloy—as will be shown later—in contrast to the ordinary copper conductor has a specific resistance about ten times as high, so that without anything further it cannot be expected that soldered connections will conduct better than equally long pieces of wire. Considering, however, the great increase in cross-section which is necessitated in making soldered joints in order to secure sufficient mechanical strength, the soldered portions in practice conduct, as a rule, better than an unsoldered piece of wire of equal length. (Cp. Mitteilungen des Kölner Bezirksverein Deutscher Ingenieure, Heft 2, 1907, p. 6.)

The resistance of a soldered joint will, however, not only be influenced by the increase of cross-section, but will also be very considerably affected by the manner in which the joint is made. It will not be a matter of indifference, in view of the very different conductivities of the copper and of the solder, whether the contact is formed by the bare wires touching one another, whereby the solder will assume the *rôle* of a protecting sleeve for ensuring contact; or whether the solder enters in between the pieces of wire to be joined and so forms the connection.

From a comparison of the conductivity of joints soldered with different soldering materials, information as to the quality of the solder can, therefore, only be obtained by simultaneously taking full account of the part played by the above influences on the variations of resistance of the joint. In making, therefore, a comparative examination of the soldered connections commonly occurring in practice (twisted and bound soldered joints), it is at least necessary to determine the resistances of the joints before soldering. It will then be seen that the cross-sectional increase due to the binding together of two wires

* From the *Elektrotechnische Zeitschrift*.

produces a noticeable diminution of resistance, so that the influence of the soldering appears to be less than would be the case were this preliminary measurement omitted. For experimental purposes, however, it would be better to prepare joints which, although unusual in ordinary practice, would enable one to a certain extent to exclude disturbing and not easily controllable influences. With this consideration in view, the following method of experiment was selected. As the expected differences would be measured

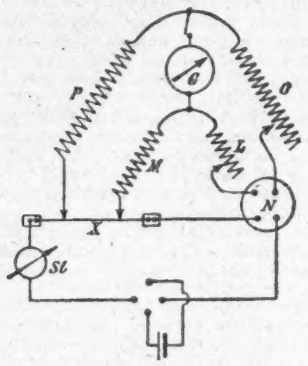


Fig. 5.

microhms, a method of connection was required in which the contact resistances of the connecting terminals could be eliminated. Further, in view of the order of magnitude of the differences, the influence of thermo-electric currents must not be lost sight of.

A Siemens & Halske double-dial resistance bridge connected on the Thomson method with two sets of dial resistances, each of $9 \times 0{\cdot}1$, $9 \times 1$, $9 \times 10$, $9 \times 100$ ohms, and two proportional arms, each having resistances of 10, 50 and 100 ohms, was used. In conjunction with four standard resistances (of 0·1, 0·01, 0·001 and 0·0001 ohm) measurements could be made with the bridge from $2 \times 10^{-1}$ to $1 \times 10^{-6}$ ohm with an accuracy within 0·1 per cent. With the connections as shown in figs. 5 and 6, the highest sensibility of the bridge is attained for the smallest testing currents.

The galvanometer was a Deprez d'Arsonval reflecting instrument made by the same firm. (Resistance of moving system 150 ohms; 1 mm. deflection with the scale at a distance of 1 metre, about equal to $25 \times 10^{-10}$.) The vertical scale was illuminated by means of a glow lamp, and a very sharp spot of light could be obtained and good readings taken, even in an undarkened room. For zero methods the accuracy of the reading is fully sufficient. The resistance and standard were connected together and to the bridge by means of thick wires and links, the resistance of which can be neglected. During the measurement the standard and resistance x were immersed in petroleum, so that the temperature could be checked with thermometers calibrated to a tenth of a degree. Higher temperatures for the determination of the temperature-coefficients were reached by agitating the bath with a burning tubular glow lamp.

To exclude thermo-electric effects the measurements were made with the current applied. An accumulator supplied the current, which was checked by a Siemens milli-voltmeter and ammeter with shunt and was reduced until during the time of the experiment no further heating of the resistance was observable. As the spot was affected but little by regulating to the last ten places, a zero adjustment was not made, but one for current reversal; and as the reading the values were taken which lay between the clearly defined reversals of the spot.

In the first place the following values were obtained for the tin solder and copper used in the subsequent tests:—

| | | |
|---|---|---|
| Tin solder (50/50):— | | |
| Specific resistance at 15° C. | = 0·1779 | ohm per sq. mm. per metre. |
| Conductivity | = 5·62 | |
| Copper (dynamo wire):— | | |
| Specific resistance at 15° C. | = 0·0175 | " " " |
| Conductivity | = 57·14 | |
| Ratio of copper resistance to resistance of solder | = 1 : 10·2. | |

For the determination of the specific resistance of the solder, ten pieces of tin-solder wire of as uniform diameter as possible were selected and cut into lengths of 50 and 250 mm. (mean diameter from micrometer measurements = 2·12 mm.).

To evaluate the resistance at 15° C. the temperature-coefficient of the metal solder was determined between 14·2° C. and 22·6° C. from the equation—

$$a = \frac{1}{w_1} \cdot \frac{w_2 - w_1}{t_2 - t_1},$$

from which $a = 0{\cdot}0061$. As in the following tests it was throughout a question of comparative values, all measurements were undertaken at approximately equal temperatures (16·2° C. to 16·4° C.), which was satisfactorily accomplished by using covered petroleum baths. Fig. 7 shows the clamping device constructed by the author for holding small resistance wires and short test lengths, with which good results were obtained. For the tests in question attachments were used with fixed test lengths of 50 and 250 mm. As with well-made screws the test-lengths can be accurately checked to less than 0·2 mm., one can easily convince oneself by calculation that the errors due to the attachment can be neglected. By repeatedly reversing the same test-piece, differences were obtained less than 0·4 microhm.

Three series of tests were carried out.

### Series No. I.

Copper wire (so-called dynamo wire) 2·45 mm. in diameter was cut into 100-mm. lengths, with which the following samples were prepared:

Sample 0: Undivided wire;
Samples 1 and 2: Butted and soldered;
Samples 3 and 4: Scarfed and soldered;
Samples 5 and 6: Wires placed over one another for a length of 5 mm. and soldered;
Sample 5: The wires were strongly pressed together in the vice and soldered, so that the contact was at the surface of the copper.
Sample 6: Soldered on chalk, *i.e.*, the ends of the wires were placed in channels made in the surface of the chalk, so that solder could run between the wires;
Samples 7 and 8: Wires put over one another for a length of 10 mm. and soldered.
Sample 7 was treated like 5 and sample 8 like 6.

The soldering was carried out with Fludor by means of a soldering iron. The measurements in I were made with a standard resistance box of 0·01 ohm absolute value (temperature-coefficient = − 0·000002); in the control tests in II the unknown resistance was interchanged with the standard, so that the values of the resistance could be read direct in tenths of a microhm on the bridge. The

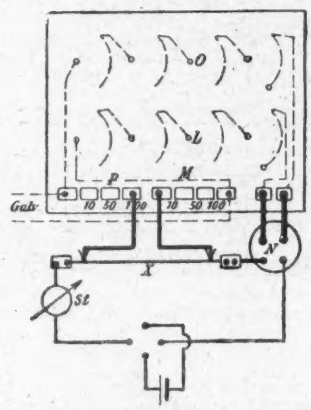


Fig. 6.

control measurements were carried out with the standard 0·0001 ohm absolute value (temperature-coefficient = + 0·000005). The testing current was 3 amperes.

The two sets of measurements showed throughout a satisfactory agreement. For instance, for Sample 8 in Test I the bridge reading was 526·9. This gives a resistance—

$$x = \frac{P}{O} \cdot N = \frac{10}{526{\cdot}9} \cdot \frac{1}{100} = 189{\cdot}79 \times 10^{-6} \text{ ohm};$$

the confirmatory measurement with the interchanged standard was—

$$x = \frac{O}{P} \cdot N = \frac{0 \times 10}{10^2} = 189{\cdot}7 \times 10^{-6} \text{ ohm}.$$

The following table gives the values obtained in microhms:—

| Sample No. | Measurements. I. Microhms. | II. Microhms. | Mean. Microhms. | Difference in comparison with Sample 0. Microhms |
|---|---|---|---|---|
| 0 | 187·6 | 187·3 | 187·5 | 0 |
| 1 | 193·0 | 192·6 | 192·8 | + 5·3 |
| 2 | 194·5 | 195·2 | 194·8 | + 7·3 |
| 3 | 199·2 | 200·5 | 199·8 | + 12·3 |
| 4 | 191·5 | 190·8 | 191·1 | + 3·6 |
| 5 | 190·7 | 190·4 | 190·5 | + 2·9 |
| 6 | 191·0 | 191·2 | 191·1 | + 3·6 |
| 7 | 179·2 | 178·7 | 178·9 | − 8·6 |
| 8 | 189·8 | 189·7 | 189·7 | + 2·2 |

The assertions previously made are thus confirmed by the test. Samples 1 to 4, in which a soldered joint was made without any increase of the cross-section, give throughout a higher resistance. The influence of the nature of the soldering is clearly shown with Samples 7 and 8. The bare wire contact established with Sample 7 produces a diminution of the resistance of about 8 microhms, whereas the solder which got between the wires in Sample 8 raised the resistance by about 2 microhms, in round figures.

### Series No. II.

With the same kind of wire similar joints were made with six different soldering materials, with the wires overlapping one another for exactly 10 mm. The wires were laid over one another, pressed together in the hand-vice and soldered with a soldering iron. The

measurements were made in the same way as in series I, with a test length of 50 mm. (Sample 0 = unsoldered wire.)

| Sample No. | Flux. | Mean of measurements I and II. Microhms. | Difference in comparison with Sample 0. Microhms. |
|---|---|---|---|
| 0 | Undivided wire ... | 187·5 | 0 |
| 1 | Fludor ... ... ... | 175·0 | −12·5 |
| 2 | Tinol ... ... ... | 175·8 | −11·7 |
| 3 | Lötan ... ... ... | 177·7 | − 9·8 |
| 4 | Zinc chloride ... ... | 176·9 | −10·6 |
| 5 | Stearine ... ... | 178·4 | − 9·1 |
| 6 | Resin ... ... ... | 178·6 | − 8·9 |

A diminution of the resistance of the joint thus occurs with all the soldering materials used. Having regard to the possible errors of measurement (up to about 1 microhm) reliable conclusions as to the quality of the soldering material cannot be drawn from the observed differences.

### Series No. III.

Determination of the order of magnitude of the alteration of resistance of soldered joints usually occurring in practice.

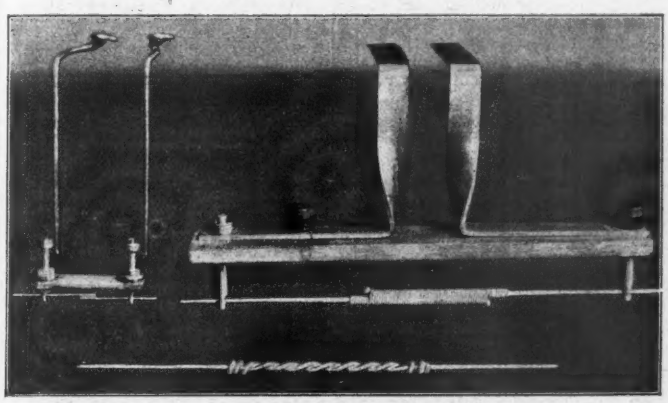

Fig. 7.

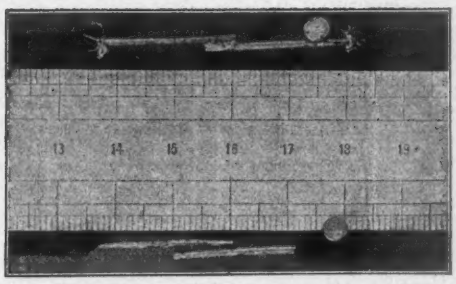

Fig. 8.

In the same way as in Series I and II, the resistance of a piece of wire 250 mm. in length and 3·57 mm. in diameter (nominally 10 sq. mm.) was first determined; with this kind of wire an ordinary twisted soldered joint and a bound soldered joint were made. The joints were measured both before and after the soldering (see fig. 7).

| Sample No. | Type of joint. | Mean from Measurements I and II. Microhms. | Difference in comparison with Sample 0. Microhms. |
|---|---|---|---|
| 0 | Unsoldered wire ... ... | 442·2 | 0 |
| 1A | Bound joint, unsoldered | 401·1 | −41·1 |
| 1B | Bound joint, soldered ... | 329·2 | −113·0 |
| 2A | Twisted joint, unsoldered | 366·0 | −76·2 |
| 2B | Twisted joint, soldered ... | 348·5 | −93·7 |

The test shows that the requirement that a wire joint should on no account produce an increase of the resistance, is fulfilled by the increased cross-section resulting from the binding together of the wires. With reference to the portion of the decrease in resistance to be attributed to the soldering, the two joints behave very unequally. Whereas with the bound soldered joints nearly two-thirds of the total reduction of resistance can be ascribed to the soldering, for the twisted soldered joint this only amounts to about two-ninths.

If, as in test series No. II, one were to form a soldered connection of two wires by simply placing the two ends of the wires over one another, the current would have to traverse a cross-section of solder equal to the diameter of the wire by the length of the overlap, on the supposition that the two wires were separated by the solder which had flowed between them. In consideration of the ten times lower conductivity of the ordinary solder, for the case that no increase of resistance of the soldered piece should occur, one would have the conditional equation:—

$$\frac{d^2\,\pi}{4} \cdot 10 = d\,l.$$

One can, therefore, say that the above-mentioned condition will be fulfilled when an actual soldered connection is obtained of a length equal to about ten times the diameter of the wire. With small cross-sections (1·5 and 2·5 sq. mm.) this requirement is easily fulfilled while using but a small quantity of solder. On the other hand, especially in jointing heavy copper bus-bars with solder, one would in certain cases be compelled to select thicker layers than are generally used in consideration of the considerably lower conductivity of the solder.

As regards the application of the preceding measurements to the comparison of the quality of different soldering materials, it can certainly be maintained that with less sensitive methods in which especially the contact resistances at the binding terminals may amount to the order of magnitude of the measured differences —*e.g.*, with the method based on Ohm's law—it can at most be laid down that the one or other soldered portion has a lower resistance than the undivided piece of wire of equal length; a more definite decision as to the quality of the applied soldering material will not, however, be arrived at, in consequence of the difficulty in satisfactorily separating the influences mentioned. Even the previously described sensitive method with the Thomson connection is not perfect as shown. For making comparisons, in addition to the electrical measurements, accurate weighings would also have to be carried out to determine the weight of solder used in each case.

Another way of conducting the experiment would be to pass heavy currents through the soldered portions until the solder began to soften and the joint to melt through, on the assumption that the local heating at the joint by the passage of the current will be, to a certain extent, dependent on the magnitude of the contact resistance.

In the experiments which were carried out on this basis, it was first necessary to determine what current-overload, wires connected only by solder would actually carry. In order that the wires might be held together by the solder only, abnormal joints were made throughout by placing the wires together and covering them to a thickness of 5 mm. and 10 mm. (see fig. 8). The soldered samples were placed in a Bergmann insulated tube (11 mm. clear width) having a box in the centre, so that the soldered part lay quite free in the middle of the box. The temperature of the interior of the box could be observed with the aid of a thermometer passing through a cork in the cover. The wires were held lightly stretched, so that they must at once separate on the softening of the solder.

Standard india-rubber-covered wire having a cross-section of 1·5 sq. mm. was employed.

#### Preliminary Experiment.

Soldered portion, soldered with Fludor, with a layer 10 mm. thick. Load: 40 amperes = four times the permissible current for the cross-section. After 50 minutes the india-rubber began to smoke; the insulation was destroyed. After 100 minutes traces of softening began to appear, when the experiment was stopped.

#### First Set of Experiments.

Soldered joints with 5-mm. layers soldered with different materials. Load: 20 amperes = double the permissible current.

The different soldered joints all carried the load for 16 minutes, *i.e.*, eight times as long as the possible working overload (for fuses, as is well known, blow after two minutes with double the permissible current) without showing any signs of softening.

#### Second Set of Experiments.

Six soldered joints with 5-mm. layers; materials, Tinol and Fludor. Loaded with 40 amperes until rupture.

By weighing the wires both before and after the soldering, the weight of solder was determined. The time of melting was observed with a chronograph.

#### Results.

| Sample No. | Material. | Weight of solder. Gm. | Time of melting. Sec. |
|---|---|---|---|
| 1 | Tinol paste 50/50 | 0·019 | 90 |
| 2 | Tinol paste 50/50 | 0·019 | 75 |
| 3 | Tinol stick | 0·041 | 84 |
| 4 | Tinol stick | 0·025 | 105 |
| 5 | Fludor paste | 0·025 | 120 |
| 6 | Fludor tin solder | 0·007 | 80 |

Whereas in this series of tests the soldering was carried out by an experienced jointer with every care, the following samples were quickly soldered without any precautions.

Third Series. Load, 56 amperes.

| Sample No. | Material. | Weight of solder. Gm. | Time of melting. Sec. |
|---|---|---|---|
| 1 | Acid and tin solder... | 0·081 | 69 |
| 2 | Resin and tin solder | 0·042 | 74 |
| 3 | Tinol stick ... ... | 0·043 | 79·5 |
| 4 | Tinol paste ... ... | 0·035 | 66 |
| 5 | Fludor tin solder ... | 0·074 | 90 |
| 6 | Fludor tin solder ... | 0·035 | 74 |
| 7 | „ „ .... | 0·065 | 188 |
| 8 | „ „ ... | 0·055 | 89·5 |
| 9 | Fludor paste and tin | 0·022 | 94 |

The tests show, in the first place, that well-made soldered joints can carry considerable overloads. Thus the objection which Weber, in his explanations of the Society's Rules (*Erläuterungen zu den Verbandsvorschriften*, 1906, p. 52, Remarks 6), expresses "that in the endeavour to simplify soldering, it should not be forgotten that metal solders with far too low a melting point can become soft by the heating which arises in ordinary working, &c.," do not apply, at any rate for the soldering materials investigated here. On comparing the times of melting and the weights of solder used, in conjunction with one's own observations of soldering, one can certainly draw from the results conclusions as to the quality of the soldering material. The fact that, for example, with an amount of solder of only 7 milligrammes, it was possible to make a reliable joint, without doubt, should be in favour of a flux.

I cannot omit to express my opinion that "electrical" tests are hardly to be recommended for the practical requirements of a test on soldering materials, owing to the large expenditure of time and care involved.

Meanwhile, I believe that for practical purposes the following series of tests will give sufficient information:—

1. Test for the amount of organic and mineral acids contained in the flux.
2. Test for the amount of corrosion of the metal.
3. Determination of the efficiency by means of mechanical tests of strength.

For a complete representation there still remain the practical tests, *i.e.*, it is necessary to make different kinds of soldered joints in order to form an opinion as to how far the process of soldering is simplified by the use of one or other soldering composition.

The overload tests and the mechanical tests for strength were conducted in the laboratories of the Königliche Maschinenbauschule, and the resistance measurements in my own private laboratory.

In conclusion, it remains for me to express my thanks to Messrs. Classen & Co., Berlin, to whose initiative this work is due, for kindly permitting me to publish the results of an investigation carried out on their behalf.

## PROCEEDINGS OF INSTITUTIONS.

### Train Lighting.

By C. M. Dowse, Stud. I.E.E.

In February last a paper was read by Mr. C. M. Dowse before the Students' Section of the Institution of Electrical Engineers, which contained much interesting matter relating to the lighting of trains by oil, gas and electricity. Commencing with a statement of the essential features of an ideal lighting system, the whole of which are not fulfilled by any existing system, the author says that even candles are still in use on some Russian lines, and they were used in Germany until the year 1900. Colza and olive oil, in spite of their inefficiency and dirty nature, have not yet disappeared from British railways. Oil-gas is widely used, compressed into receivers at a pressure of 150 lb. per sq. in., and recently incandescent gas mantles of the inverted type have been adopted. In 1905 it was reported that of 160,000 coaches in use on European railways, 58 per cent. were lighted by gas, 36 per cent. by oil, and only 6 per cent. by electricity. In America more than 60 per cent. of the coaches are lighted with oil-gas.

A fairly good light is given by gas, which is also reliable and cheap; but the records of railway accidents show that it adds a grave risk of fire to the horrors of these, and Lieut.-Col. Donop, Board of Trade Inspector, has strongly recommended the substitution of electricity for gas. The development of electric lighting, however, is retarded by the increased first cost, lack of standardisation, and the indifference of the public.

The demands of railway officials are somewhat unreasonable. They ask for a means of sufficiently and safely lighting a carriage, such that complete independence may be obtained, and the coaches may be ready to run anywhere at any time. Gas lighting cannot comply with these stipulations, and apart from the question of safety, the reservoirs must be refilled in sidings, and the trains be withdrawn temporarily for this purpose. Accumulators, with a dynamo to take up the load and keep the cells charged, seem to be the most promising scheme. It is difficult, however, to maintain the insulation of the cells perfect, and the plates may sulphate if allowed to stand when discharged. On the Great Northern Railway of Ireland all the passenger coaches are so fitted, on the Stone system; breakdowns occur chiefly through the accumulators, there being a leakage current across the lid of a cell which corrodes the lead lug, and the lead lining of the box being perforated by splashed acid. Adequate inspection would overcome these troubles. Again, batteries may by faulty regulation be overcharged, or discharged by short runs and long rests. On the North Staffordshire line (Stone system) the engineer reports that the voltage of the cells is well maintained on main line trains, which have long runs and but few stops, but on local short runs with many stops, the discharge to the lamps in the winter months is so great that the P.D. becomes low. The care and constant attention needed for the satisfactory maintenance of a stationary battery must be redoubled when the battery is subjected to alternate charge and discharge at rapidly varying rates, and to the ill-treatment it must undergo from its position on a jolting carriage.

With a simple battery of cells in each guard's van, all the difficulty of regulation disappears, and the cells may be inspected with ease; but this method will never be universally adopted, because all possibility of independence is sacrificed. It is in use on the East and West Junction and Stratford-on-Avon Railway; the engineer reports that the lamps are of 10 C.P., and are supplied from Chloride cells in the brake van at 30 volts. The cells are removed every day for recharging. The chief troubles are bad connections and buckled plates. On this system electric light has been found cheaper, cleaner and more easily manipulated.

The fact that in 1901 more than half the electrically lighted trains in Germany used this system, proves that under certain circumstances it can give satisfaction. In France, the Chemin de Fer du Nord has used the system, batteries of 12 cells being fitted to 72 carriages, and the cells charged in place. The positive sections lasted two years and the negatives five years. The average number of failures was three a month. Lighter batteries could have been employed, especially if high-efficiency lamps had been substituted for the 4-watt lamps used. It is not advisable, however, to reduce the weight of the cells for a given output, on account of the loss of strength.

The plates should be arranged longitudinally, and a thick lining of flannel or cloth should be used to protect them from being thrown violently against the sides of the box. The boxes should be of wood lined with lead, and as deep as possible, with good ventilation in the covers. For combination systems moderately stout formed plates are recommended, or plates of the Chloride type, these being better able to endure large variable discharge rates than pasted plates. The Chloride Co. has brought out a new cell specially adapted for train lighting, the positives consisting of antimonial lead with the usual circular holes, into which are forced coils of corrugated lead tape, and the negatives being made in halves, riveted together and filled with active material. Specially-prepared grooved wood separators are placed between the plates, making the whole cell practically a solid mass.

In combination systems, the dynamo may be fixed on the engine and the cells in boxes under each coach; or the dynamos may be in the guard's van; or each coach may be equipped with a dynamo and battery. The last-named method appears to be the most suitable for modern railway traffic.

The first system has been employed on the Prussian State Railways, the dynamo being driven by a De Laval turbine. It has also been tried in America, but has gradually been displaced by other arrangements. The Great Northern Railway Co. has used, on 99 out of 177 coaches lighted by electricity, a system comprising a dynamo and cells in the brake van, for some years past.

Mr. Dowse then proceeds to discuss in detail several systems in which each coach is independently equipped, remarking that for such the first requisite is robust construction, to which must be added reliability and simplicity. The systems chiefly in use on British railways are the Stone, the Leitner-Lucas, and the Vickers-Hall, the first-named being most widely employed, thanks, partly, to its simplicity, and partly to its having been for many years the only system available.

In conclusion, the author compares gas and electric lighting on the bases of general convenience; cost of installation, consumption and maintenance; and distribution. It is shown that electric lighting is superior to gas lighting, by reason of its greater flexibility, safety, economy, ease in manipulation, reliability, cleanliness and steadiness.

On the other hand, the equipment for gas costs less than one-third as much as the Stone system, which is the simplest and cheapest of the self-contained electric systems. To the cost of the gas installation, however, must be added the cost of the works for the generation of the gas and the cost of transporting in reservoirs, extra sidings, &c. The depreciation on dynamos is about 12 per cent.; on batteries, 15 per cent.; and on gas plant about 7 per cent. A double battery of 24 cells, of 150 A.H. capacity, costs from £25 to £40.

The average cost of oil-gas lighting is 0·03d. per candle-hour. The North Staffordshire Railway finds that a 5-C.P. glow lamp costs 13s. 4d. per annum, and assuming that the lamp burns 360 days for five hours a day, the cost per candle-hour is 0·018d. The Great Northern Railway of Ireland has 375 coaches fitted with electric light, costing £6 per coach per annum, exclusive of capital charges. Assuming a total of 80 C.P. in use for 360 days of five hours each, the cost per candle-hour is 0·01d. The Great Northern of Scotland Railway has 98 carriages equipped with the Stone system, costing, without depreciation, £11 10s. per coach per annum. The cost for gas is given as £5 10s. The North British Railway gives 7s. 6d. as the annual cost of one 8-C.P. lamp, equivalent to 0·006d. per candle-hour. One firm offers to keep its apparatus in order for £5 per annum, and with depreciation on the equipment this means about £10 per coach per annum; as one of these coaches has lamps giving a total of 200 C.P., this brings the cost to 0·007d. per candle-hour. The variation in these figures shows the hopelessness of attempting to fix an exact cost, but, at any rate, they show that electric lighting is at least not more expensive than gas lighting.

The cost of working with cells alone on the French railways was approximately 0·0325d. per candle-hour.

On the score of distribution of light, electricity is superior to gas. Observations taken with a portable photometer prove this.

The author concludes that the only satisfactory system is an electrical one, and the only difficulty is the choice of a system. The accumulators constitute the weakest part of all systems.

## The Economic Distribution of Electric Power from Blast-Furnaces.

By B. H. Thwaite, A.M.Inst.C.E.

(*Abstract of Paper read before the* Iron and Steel Institute *at Vienna, September*, 1907.)

To those who strive for the prevention of waste of fuel and of power, and the reduction of the incubus of dead charges on working costs, the successful solution of the problem of harnessing electric energy for driving heavy rolling-mills is a fact of great economic significance.

Unlike the blast-furnace (which may work steadily on, year in and year out, without week-end or other stoppages), the rolling-mill may or may not remain steadily employed: a paucity of orders may mean the closing down of the mill for weeks, because, although pig-iron may be stocked with little or no risk, it is not usual to stock mill products which may never be wanted. During this non-operating period the blast-furnace gas used for firing the steam boilers is set free or blown into the air. This waste of fuel may be cut down considerably, if not entirely, by the application of the pooling system to be described, which involves the displacement of steam by gas power. Modern gas power electrification methods will set free a great volume of gas which, thermo-dynamically converted in a gas engine, will increase the power equivalent of such gas by 300 to 400 per cent.

The basis of this programme is to pool the waste furnace gases from all the furnaces of an iron-making district, independently of the ownership of such furnaces. The energy (electrically transformed) of the different furnaces would be transmitted to a central distributing and transforming station, in which the current would be transformed to the pressure to satisfy different customers.

The first call on this power would, of course, be the satisfaction of the internal demands of the iron and steel works, the balance of power remaining being available for external distribution over a wide area, the extent of which, owing to the familiarity with and knowledge of the resources and safety of high-pressure transmission systems, is being yearly increased. When the author put forward the first long-distance electrical transmission project of over 100 miles in 1892, the line pressure specified was 20,000 volts; to-day, transmissions of 250 miles with 88,000 volts pressure are in daily service.

The pooling programme proposed would be provided by a separate and distinctive joint-stock electric power organisation, on the lines of the county electric power companies, which sprang from the author's 1892 proposition, with the exception that a proportion of the output is preferentially allocated to the satisfaction of the power demands of the iron and steel works from which the gases are drawn. The balance could be transmitted to any group of customers whose power demands justified the cost of distributing mains and associated transforming stations, but a more appropriate field of demand for an all-the-year supply would be the satisfaction of the electric energy requirements of the many profitable electro-chemical and electro-fusion processes described in the author's paper read before this Institute at Glasgow in 1901.

Included amongst these processes are the production of high-class steel from selected scrap, special alloys, such as ferro-silicon and ferro-titanium, ferro-chromium, besides the production of carbides (silicon and calcium). Some of these processes could take the electricity just as supplied, in large or small proportions, and at any moment, so that the levelling-up of the load or the demand could be readily effected—obviously an important factor in the economic production and sale of electricity.

As an example of the kind of power demands that would be found in an average field of industrial operation surrounding iron-works, exclusive of the municipal and rural demands for current for lighting and tramway power purposes, the following is given to represent a German district for which the pooling system was first outlined by the author:—

| | Electric horse-power. |
|---|---|
| For the coal mines in the district ... ... | 1,300 |
| Chemical (metallurgical) requirements ... | 2,500 |
| Electro-chemical requirements ... ... | 1,500 |
| Works and town electric lighting ... ... | 500 |

In large districts, the power-driving requirements of the factories would provide a demand running into thousands of horse-power. The satisfaction of electric transport power requirements is becoming an increasing factor both for water and rail transport services. Besides removing the many smoke-stack polluters of the atmosphere, the additional profit would increase the stability of the iron industry of this country.

The flexible demand for power which it would be the aim of the power organisation to secure would be appropriate for the intermittent periods of mill idleness, whether temporary or prolonged; for instance, the sudden release of power for external services at the week-end periods of mill idleness (or during longer periods of compulsory idleness due to the falling off or cessation of orders) would be available for one or other of these flexible power demands.

Another and important argument in favour of the pooling policy is the fact that some 4,000 to 5,000 kw. of energy is the minimum demand of many of the most desirable of the electro-chemical and other operations, so that in a single works, without a drastic reorganisation of the plant, it would be impossible to secure this output of electric energy; whereas, by the pooling of the available power from several works, this power would be obtained with little change from existing conditions.

The following table gives an impression of the power available from several works in a district, without any change of plant and operations, to secure the fullest possible economy of the waste gases. The works, although in one district, are scattered:—

| | Kilowatts available for external services. |
|---|---|
| District A, one furnace always available ... | 1,490 |
| District B, two furnaces ... ... ... | 2,700 |
| District C, one furnace ... ... ... | 1,700 |
| Total available ... ... | 5,890 |

By the pooling system a minimum total power potential of 5,890 kw. is available, and this would justify the setting up of electro-chemical and electro-metallurgical apparatus.

The policy of pooling furnace gases is the basis of an Act of Parliament which received the Royal Assent last year, and applies in an area some 400 square miles in extent, including in the area many furnaces belonging to separate firms.

Supposing it became financially imperative to blow out the furnaces, what about the supply to the pooling station under these circumstances? The author has solved this difficulty by designing a generator that, harnessed to the furnace gas cleaning plant, produces gas of more or less exactly the composition of furnace gas.

The combustible portion of a typical example of this gas is chemically constituted as follows:—

| | |
|---|---|
| Carbon monoxide ... ... ... ... | 32·4 per cent. |
| Marsh gas ... ... ... ... ... | 0·4 „ |
| Hydrogen ... ... ... ... ... | 1·6 „ |

The cost of this apparatus is small, because the cleaning plant and associated gas mains are those installed for the furnace gas. Such a generator, of the generating capacity of the pooled gas proportion from a given furnace, would be available within three hours' notice, and the simplicity of the apparatus makes the question of depreciation during standby periods of little or no economic importance. The fluid slag from this generator can be readily converted into slag wool. This furnace type of gas generator, designed by the author, is being adopted by one of the most important Continental iron firms to compensate for the vagaries of furnace output, and is also to be used in the above-mentioned Parliamentary proposition.

Recapitulating the advantages of pooling, it may be said that besides facilitating the electrification of the rolling mills by the reduction in capital cost of plant, it will secure, in addition to the advantages of electrical driving, a substantial increase in the proportion of the furnace power gas available by the suppression of the mill steam boilers. The pooling proposition will constitute an ideal combine, securing an all-round benefit to the ironmaster and the power consumer, and will tend to promote the establishment of new electrical industries and thus enlarge the field of demand for power; it will financially justify expenditure in apparatus and on technical changes to secure the fullest possible economy in the use of furnace gas in the works. Of course any available gas from associated coke oven plant, subject to certain mixing operations to reduce the proportion of hydrocarbon in the combined gases, will be available for the pooling station.

## NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

21,054. "Improvements in instruments for transmitting and receiving ranges or the like." C. N. Paun. September 23rd.

21,039. "Improved ring or nut for securing shades to incandescent electric lamp-holders." J. Barnes. September 23rd.

21,073. "Improvements in and relating to windings of dynamo-electric machines." Siemens Bros. Dynamo Works, Ltd., and M. Kloss. September 23rd.

21,077. "Improvements in electromotors." C. A. Allison. (H. Behan, United States.) September 23rd. (Complete.)

21,083. "Improvements in electric signs and the like." J. H. Graham and A. E. Abrahams. September 23rd.

21,087. "Improvements in diaphragms or tympans for phonographic and telephonic apparatus." J. G. Coombs. September 23rd. (Complete.)

21,104. "Magazine fuse for electric light and power circuit." P. B. Fletcher. September 23rd. (Complete.)

21,106. "Improved system of single and multiplex telegraphy." S. Eisenstein. September 23rd.

21,119. "Improvements in electric indicators." C. von Perz. September 23rd. (Complete.)

21,127. "Improved anti-vibration device for the electric lamps of automobiles, carriages, and the like." J. Oldfield and R. A. Oldfield. September 23rd.

21,145. "Improvements in and relating to electrical fittings." E. G. Sheppard. September 24th.

21,167. "Improvements in switches for electric circuits." E. Pirdschun. September 24th.

21,173. "Improvements in or relating to automatic switches for use in electric circuits." Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke G.m.b.H., Germany.) September 24th. (Complete.)

21,174. "Improvements in or relating to switches, relays, measuring instruments, and the like, for use in electric circuits." Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke G.m.b.H., Germany.) September 24th. (Complete.)

21,176. "Electric signal system." A. L. Sohm. September 24th. (Complete.)

21,197. "Improvements in or relating to mountings or fittings for tubular incandescent electric lamps." D. Assersohn. September 24th.

21,224. "Improvements in and in the manufacture of boron and in the production of electric incandescing bodies therefrom." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) September 24th.

21,225. "Improved methods of varying the speed and power factor of asynchronous motors." Ateliers Thomson-Houston. (Anciens Etablissements Postel Vinay.) (Date applied for under Patents Act, 1901, September 25th, 1906, being date of application in France.) September 24th. (Complete.)

21,228. "Improvements connected with trolleys for electric traction." F. G. Holmes. September 25th.

21,243. "New or improved cleat for wiring electric and telephone wires." R. U. Cruikshank. September 25th.

21,252. "System for wireless telegraphy and telephony." L. Maiche. September 25th. (Complete.)

21,255. "Improvements in or relating to electrical fuses or cut-outs." E. J. Coller. September 25th.

21,271. "Improvements in apparatus for measuring electrical resistance." Eversheb & Vignoles, Ltd., and S. Evershed. September 25th.

21,273. "Improvements in and relating to magneto-electric machines for ignition purposes." C. A. Vandervell and F. I. Hoffman. September 25th.

21,299. "System of directed wireless telegraphy." E. Bellini and A. Tosi. September 25th. (Complete.)

21,307. "Improvements in filament supports for electric incandescent lamps." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) September 25th.

21,308. Improvements in and relating to switch mechanism." Allgemeine Elektricitats-Gesellschaft. (Date applied for under Patents Act, 1901, September 26th, 1906, being date of application in Germany.) September 25th. (Complete.)

21,332. "Improvements in or relating to electrically-heated apparatus." W. H. Welch, and H. Frost & Co., Ltd. September 26th.

21,336. "Improvements in and relating to electric plugs and sockets." J. C. Chalmers and W. A. Robertson. September 26th.

21,341. "Improved globe or shade-holder for inverted incandescent and other gas lights and for electric lights." The Birmingham Lamp and Gas-fittings Co., Ltd., and A. E. Davies. September 26th.

21,363. "Improvements in or in connection with the control of electric motors." J. S. Raworth and A. B. Raworth. September 26th.

21,389. "Sparking plug for explosion engines." H. Benoist. (Date applied for under Patents Act, 1901, September 29th, 1906, being date of application in France.) September 26th. (Complete.)

21,403. "Improvements in combined electric and percussion primers for ordnance." S. A. de Castilho. September 26th.

21,407. "Improved brush-holder for dynamo-electric machines." A. J. Garratt. September 26th.

21,408. "Improved detector for wireless telegraphy." W. P. Thompson. (Ges. fur drahtlose Telegraphie m.b.H., Germany.) September 26th. (Complete.)

21,414. "Improvements in electrical transmitting apparatus for controlling the sighting of guns." A. T. Dawson and G. T. Buckham. September 26th.

21,438. "Suspenders for electrical conductors." W. E. Gray. September 27th.

21,460. "Improvements in armature windings." Siemens Bros. Dynamo Works, Ltd., C. Altmann and W. Lau. September 27th. (Complete.)

21,467. "Improvements in or relating to electricity meters." Elektrizitats Akt.-Ges. vorm Schuckert & Co. (Date applied for under Patents Act, 1901, October 3rd, 1906, being date of application in Germany.) September 27th. (Complete.)

21,475. "Improved electric battery, also applicable for the manufacture of sulphuric acid." L. P. Basset. (Date applied for under Patents Act, 1901, October 2nd, 1906, being date of application in France.) September 27th. (Complete.)

21,476. "Improved manufacture of incandescent electric lamps having metal filaments." A. G. Bloxam. (Siemens & Halske Akt-Ges., Germany.) September 27th. (Complete.)

21,478. "Holders for carbons of arc lamps." H. Ashton. September 27th.

21,493. "Improvements in and relating to repulsion motors." O. Mietens and R. Trechcinski. September 27th.

21,507. "New or improved electrical stop motion for engines." J. E. Sweet and A. H. Waite. September 28th.

21,510. "Improvements in or connected with electric switches." I. Vlasto, T. Clark and W. Watson. September 28th.

21,516. "Automatic switch for electrical transformers." P. Good. September 28th.

21,531. "Improved electrical telegraphic and mechanical transmitter." W. Hamilton. September 28th.

21,535. "Improvements in and relating to electric transformers." L. Maiche. (Date applied for under Patents Act, 1901, December 6th, 1906, being date of application in France.) September 28th. (Complete.)

21,537. "New or improved pole for operating the trolley arms of electric tramcars and like vehicles." M. Webster. September 28th.

21,544. "Improvements in and relating to internal combustion engines." A. P. Cairns and T. W. Cairns. September 28th.

21,551. "Improvements in control systems for electrically-propelled vehicles." W. Cooper. (Date applied for under Patents Act, 1901, October 3rd, 1906, being date of application in United States.) September 28th. (Complete.)

21,569. "Improvements in or connected with telephone receivers." E. Durand. September 28th.

21,574. "Improvements in induction coils for generating high-tension current." W. P. Thompson. (Polyphos-Elektrizitats G.m.b.H., Germany.) September 28th.

21,579. "Improvements in and relating to wireless tranmission of electric emanations." H. G. Matthews. September 28th.

21,584. "Improvements in dynamo-electric machines." J. Burke. (Date applied for under Patents Act, 1901, February 4th, 1907, being date of application in United States.) September 28th. (Complete.)

21,588. "Improvements in or relating to electric controllers for railway service and the like." T. von Zweigbergk. September 28th. (Complete.)

## PUBLISHED SPECIFICATIONS.

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### 1906.

Conductive Filaments for use in Electric Lamps or other Apparatus. The British Thomson-Houston Co., Ltd. (General Electric Co., U.S.) 19,748. August 21st.

Electric Driving Attachment for Adding Machines. A. J. Boult. (Burroughs Adding Machine Co., U.S.) 18,638. August 20th.

Prepayment Attachments for Electricity Meters. E. Peacock. 18,665. August 20th.

Supports for Metallic Filaments for Electric Incandescent Lamps. A. Lederer. 18,812. August 22nd.

Alternating Current Dynamo-Electric Machinery. A. Scherbius. 18,817. August 22nd.

Electric Incandescent Lamps. A. Lederer. 18,875. August 23rd.

Electrodes and Separators for Secondary Batteries. H. F. Joel. 18,886. August 23rd.

Electric Ignition for Explosion Engines. A. J. Boult. (L. de Loma, France.) 19,037. August 25th.

Systems of Electrical Distribution in which Vapour Electric Devices are Employed. P. H. Thomas. 19,461. August 31st. (Date applied for under International Convention, September 1st, 1905.)

Junction-Boxes for Electric Cables. W. T. Henley's Telegraph Works Co. and W. H. Nichols. 21,167. September 24th.

Manufacture of Electric Conductors of Refractory Metal. The British Thomson-Houston Co., Ltd. (General Electric Co., U.S.) 21,511. September 29th.

Manufacture of Filaments for Incandescence Electric Lamps. J. Y. Johnson. (Dr. Hollefreund & Co., Germany.) 21,654. October 31st.

Electric Warming Devices. R. F. Laffoon. 22,716. October 13th.

Electrical Connectors, more especially of the Type used for Bonding Rails. The British Thomson-Houston Co., Ltd. (General Electric Co., U.S.) 22,717. October 13th.

Electrostatic Voltmeters. E. J. Murphy and Kelvin & James White, Ltd. 26,131. November 19th.

Device for Eliminating Interference between Telephonic and Telegraphic or Low Frequency Currents Transmitted Simultaneously over the same Line. C. Duo. 27,317. November 30th.

Points or Switches for Electric Tramways Working upon the Slot Conduit System. M. O. Spicknall and J. G. White & Co., Ltd. 27,728. December 5th.

Electrical Ignition Devices for Internal Combustion Engines. A. R. Bellamy. 29,050. December 20th.

Electric Switches. British Thomson-Houston Co. (General Electric Co., United States.) 16,602. July 23rd.

Arc Lamps. R. P. Myers. 17,077. July 28th.

Alternating Electric Current Motors and Systems of Operating and Controlling Same. British Thomson-Houston Co. (General Electric Co., United States.) 18,956. August 24th.

Electric Automobiles. J. W. Mackenzie. (United States Motor Vehicle Co.) 18,976. August 24th.

Circuit Protecting Devices. British Thomson-Houston Co. (General Electric Co., United States.) 19,235. August 28th.

Electric Batteries. W. J. L. Sandy and H. T. Middleton. 19,623. September 3rd.

Primary Batteries. H. Sefton-Jones. (Decker Electrical Manufacturing Co.) 19,951. September 7th.

Galvanic Batteries. H. Sefton-Jones. (Decker Electrical Manufacturing Co.) 19,951c. September 7th. (Date applied for under Rule 5, Patents Rules 1905, September 7th, 1906.)

Automatically Operating Telegraphic Mechanism for Transmitting Predetermined Messages, Particularly Applicable for Fire Alarm Apparatus. C. Smith. 21,059. September 22nd.

Joints Between Electric Conductors, Especially Applicable to Joints for Electric Incandescent Lamp Conductors. British Thomson-Houston Co. (General Electric Co., United States.) 21,506. September 28th.

Process for Electrically Welding the Longitudinal Joints of Tubular Objects, such as Boiler Shells, Tubes, Pipes and the like. E. Bier. 23,269. October 20th.

Controllers or Cut-Outs for Electrical Circuits. C. C. Garrard and Ferranti, Ltd. 24,208. October 30th.

Electric Transformers. British Thomson-Houston Co. (General Electric Co., United States.) 24,397. October 31st.

Flame Arc Lamps. C. E. G. Gilbert. 24,576. November 2nd.

Conduit Fittings for Electric Wires and Cables. Oldbury Steel Conduits, Ltd., and W. W. Hackett. 26,678. November 24th.

Electric Furnaces. British Thomson-Houston Co. (General Electric Co., United States.) 26,887. November 26th.

Electric Motors. R. H. Parker. 27,205. November 29th. (Date applied for under International Convention, December 4th, 1905.)

### 1907.

Means of Working and Control of Petrol Electric and Electric Cars. W. A. Stevens. 327. January 5th.

Dynamo-Electric Machines. J. E. Hoeggerath. 1,100. January 15th. (Date applied for under International Convention, January 16th, 1906.)

Telautographic Systems. 1,548. A. Korn. January 21st.

Signalling in Wireless Telegraphy. V. Poulsen. 4,809. February 27th.

Prepayment Electric Meters. L. A. Berland. 4,828. February 27th. (Date applied for under International Convention, July 10th, 1906.)

Connection System for Alternating Current Commutator Type Motors. B. G. Lamme. 5,507. March 7th. (Date applied for under International Convention, August 2nd, 1906).

Device for Connecting Wires to Telephone Receivers. C. Brunnschweiler. 8,611. April 13th.

Methods of and Apparatus for Refining Tin Electrolytically Particularly for Extracting Pure Tin from Alloys, Wastages, Residues, and the like, with the Extraction of the Foreign Metals. O. Steiner. 10,280. May 2nd. (Date applied for under International Convention, February 1st, 1907.)

Electrodes for Search Lights. Geb. Siemens & Co. 14,847. June 27th. (Date applied for under International Convention, September 26th, 1906.)

Wireless Telegraphy. L. de Forest. 3,880. February 11th. (Date applied for under International Convention, February 14th, 1906.)

Wireless Transmission of Sonorous Vibrations. V. F. Feeny. (McCarty Wireless Telephone Co.) 5,582. March 7th.

Dynamo-Electric Machines and Means for Controlling the Same. Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke Ges.) 6,715. March 20th.

Brush-Holders for Dynamo-Electric Machines. E. M. Tingley. 6,895. March 22nd. (Date applied for under International Convention, April 4th, 1906.)

Pole Pieces of Electrical Machines. Unione Elettrotecnica Italiana. 7,836. March 27th. (Date applied for under International Convention, March 28th, 1906.)

Reflectors for Electric and other Lamps. H. Tartsch. 9,017. April 8th. (Date applied for under International Convention, April 20th, 1906.)

Holders for Electric Lamps and Shades. J. A. Gosling. 11,528. May 17th.

Alternating-Current Commutator-Electric Machines. Allgemeine Elektricitäts Ges. 633. January 9th. (Date applied for under International Convention, January 29th, 1906.)

Brush Carriers of Electric Machines. Krieger and Compagnie Parisienne des Voitures Electriques. (Procédés Krieger.) 5,203. March 4th. (Date applied for under International Convention, October 16th, 1906.)